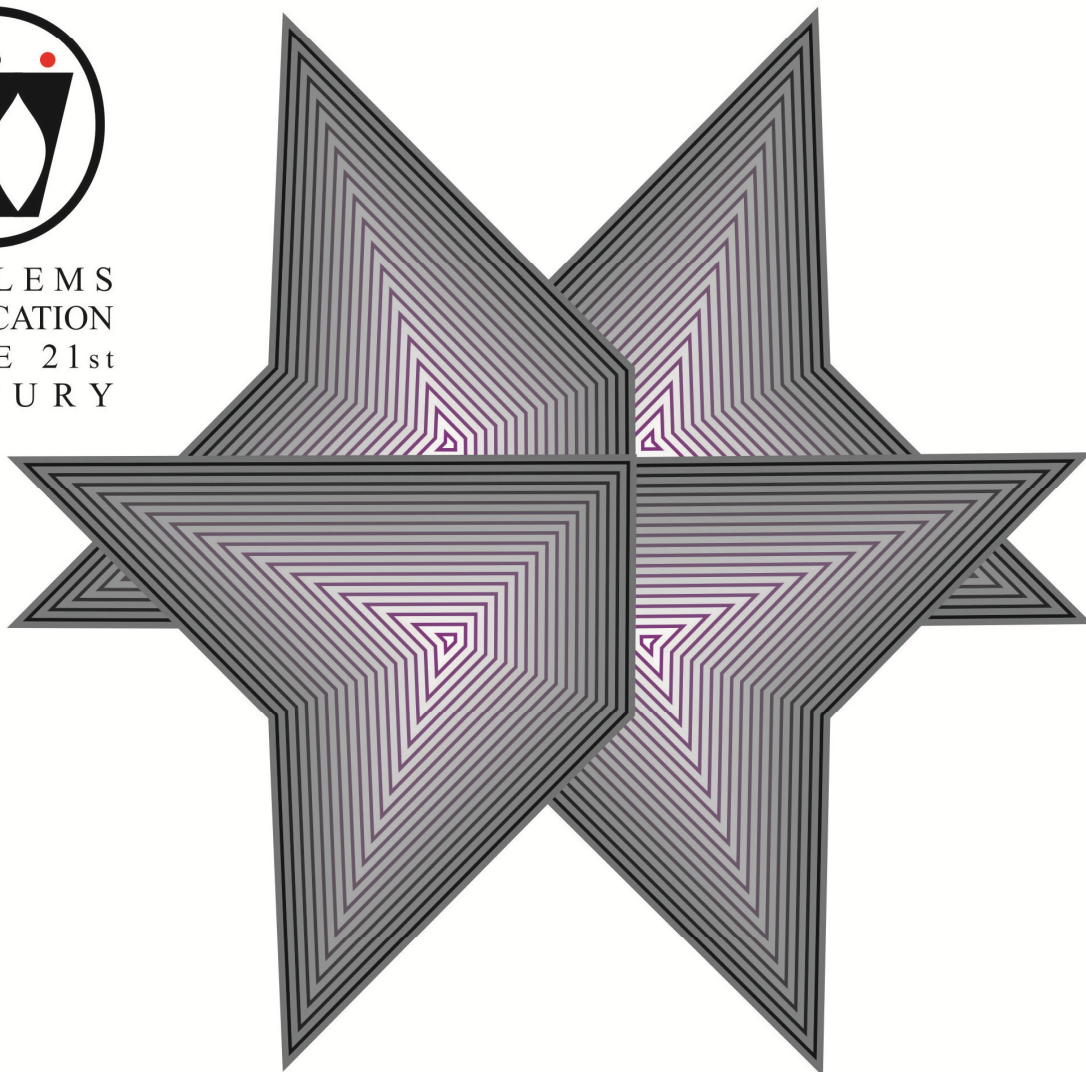


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SCIENCE, CRITICAL THINKING, MULTI-ATTRIBUTE DECISION MAKING

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Science is the pursuit and application of knowledge and understanding of the natural and social world following *a systematic methodology based on evidence*. Science includes scientific methods such as *objective observation*, which refers to measurement and data (possibly, although not necessarily, using mathematics as a tool), evidence, experiment, critical analysis, and verification. The four major branches of science are: *mathematics and logic, biological science, physical science, and social science*. The key words that best define science are thus:

*objective observation + evidence-based approach + application of scientific methods =
general truths*

The basic problem of such an explanation of science lies in the very definition of what *general truths* are, what kind of evidence is required to prove them, and how to arrive to this kind of evidence through *objective observation*. The simplest premise to answer these questions would be: through *logic and critical thinking*. But let us start at the beginning, with a fundamental question: *what is truth? What is a general truth in this context?*¹ Let us analyse a generally accepted fact: water boils at 100 degrees Celsius, as a general truth. It soon becomes clear that while this statement may be true in a broad sense, it is not a general truth, since this depends (at least) on the pressure (or on the altitude), at which the measured water is located. The conclusion is that the truth is a complicated or *multi-attribute problem*. Let us consider this issue on the example of artificial intelligence (AI).

Talking about AI has become one of the most topical subjects of the moment, although many people who think they know a lot about this subject, in fact know almost nothing at all (Aberšek, 2021). Others, who know a lot, are convinced that they know nothing (remember the Socratic paradox, "*I know that I know nothing*"). However, the underlying problem lies in the very definition of the term artificial intelligence, because at least two types of AI exist: artificial general intelligence (AGI) or strong AI, and weak or narrow AI. We also have to ask ourselves the question of who we are, and how we perceive the world around us? We may either be experts, pseudo-experts, or laymen, operating at different levels of consciousness. With regard to this division, one may start from the basic pedagogical premise – the three-level scale of knowledge acquisition:

1. The basic starting level is: *I do not know that I know nothing!*
2. The next level is: *I know that I know nothing!*
3. Only after one realizes this (Level 2), they may shift to the next hierarchical level by performing a personal (first-person) analysis of one's competence and come to the conclusion: *I know that I can!* But the Dunning–Kruger effect which is a cognitive bias whereby people with low ability, expertise, or experience regarding a certain type of a

¹ *General truths*: the present simple is used to express facts that are always true or events that always happen. This use is often described with the term "general truth": *The sun rises in the east or Water boils at 100 degrees Celsius*.

task or knowledge tend to overestimate their ability or knowledge² also must be taken into account.

4. Finally, there is the execution level, where an individual's interest (motivation) comes into play, for example: *I can, and I want to*; or *I can, but why should I?*

Unfortunately, the majority of those who have mastered the first three levels often show a lack of interest or motivation to *actually do something*. Even more people too often stay only at the first level (*I do not know that I know nothing*, or worse, an attitude of general ignorance – *I already know everything there is to know*) and skip the second and third levels. In many fields of science there are very few scientists who do understand and who are able to do something, and then there are many different pseudo-scientists (we could call them ‘preachers’) who do not understand the problem at hand (they don’t possess the knowledge) and who do not understand that they are not able to resolve it (because they don’t have the basic intellectual capacity) – but so often these people do have interests and they take the right to preach and explain the truth. And this is the essence of the difference between science and pseudo-science (faith): science requires *knowledge* and *understanding* alongside a great deal of personal *skepticism*. With faith, one needs only an interest (motivation) in order to proclaim some kind of ‘truth’, which does not require scientific evidence. Considering the level of intellectual abilities of these preachers, “proclaimers of the truth”, these “truths” are more or less simplified and adapted to the level of the target audience. And unfortunately, in the world of science, the balance is tipped more and more towards such preachers, who always seem to be in the majority. And if we don’t believe them, it will be our own fault (unconditionality is the essence of faith: only if you truly believe, X will happen; if X doesn’t happen, it is because you did not have enough faith – in other words, the fault always lies with the believer and never with the expositor of the faith), whether the matter at hand is environmental changes, a pandemic, global warming or any out of a number of other complex problems. This means that science tends to lean towards an increase in entropy and the negation of science (Aberšek, Flogie, 2022). In short, to provide a scientific explanation, we need knowledge about the complexity of the problem, and we need critical thinking to be able to judge (assess, evaluate) a problem and its possible solutions.

Experts generally analyse problems by breaking complex problems into more knowable parts. The quality and accuracy of such analysis depend on the strength of the science used to assess each part. Science is reasonably strong for well-known phenomena (our awareness – we believe that we understand), such as environmental problems, ecological footprint, or nuclear power. Still, it is a different story for new technologies such as AI, physical cybernetics systems (robots), self-driving vehicles or Covid. When scientific understanding is incomplete, analysis shifts from reliance on facts to expert judgment, and studies of those judgments find that they are often quite good – but only when experts get good feedback.

However, with new technologies such as the self-driving car or AI algorithms, feedback will be a long time coming. Until it does, we will be unsure – and the experts themselves will not know – how accurate their risk estimates are. How, then, can researchers in this area fulfil their duty to inform people about accurate ways to think about events and choices that are beyond their experience? Scientists can accomplish this if they follow two fundamental lessons from studies of decision-making: critical evaluation and thinking, and multi-attribute decision making.

Critical Thinking

Critical thinking is the intellectually disciplined process of actively and skilfully conceptualizing, applying, analysing, synthesizing, or evaluating information gathered from,

² for more see: <https://www.britannica.com/science/Dunning-Kruger-effect>

or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Elder & Paul, 2009). The top five critical thinking skills could be: Observation, Analysis, Inference, Communication and Problem Solving.

Critical thinking is self-guided, self-disciplined thinking which attempts to reason at the highest level of quality in a fair-minded way with the use of the intellectual tools that critical thinking offers – concepts and principles that enable them to analyse, assess, and improve thinking. Critical thinkers must avoid thinking simplistically about complicated and complex issues (pseudo-science) and appropriately consider the rights and needs of relevant others. They recognize the complexities in developing as thinkers. They embody the Socratic principle: *the unexamined life is not worth living, because they realize that many unexamined lives together result in an uncritical, unjust, dangerous world* – which is the result of the situation in the world today.

Problem Solving – Multiparameter Analysis

Let us now turn our focus on the minority that understands and is motivated to take action – on scientists and the scientific interpretation of truth. The basic premise must be that problems are always complex (i.e., non-complex problems are not real problems) since it is obvious that the world is becoming increasingly complex and interconnected, and that some of our biggest challenges have begun to seem intractable. How will climate change play out? How does AI work? Our traditional approaches to these problems are often qualitative and disjointed and lead to unintended consequences. To bring scientific rigor to the challenges of our time, we need to develop a deeper understanding of complexity itself. A high complexity of problems requires a highly complex approach, which is most often described in science using the Theory of Complex Systems³. In general, the decision-making problem can be defined as (Bohanec, 2020) which developed DEXi⁴:

1. *Given* a set of alternatives $\mathcal{A} = \{A_1, A_2, \dots, A_n\}$ and (somehow expressed) aims or goals of the decision maker(s), and
2. *find* alternative $A_i \in \mathcal{A}$ that best satisfies the goals.

In the field of science, multiparametric analysis involves collecting data from a range of inputs to make an accurate diagnosis. Based on multiparameter analyses, we can make multi-attribute decisions. Utility functions are the components of multi-attribute models that define the aggregation aspect of option evaluation. In multi-attribute decision making, the decision problem is decomposed into a number of smaller, less complex subproblems. Alternatives are decomposed onto different dimensions, usually called attributes, criteria, goals, etc. These are evaluated independently. For each aggregate attribute Y , whose descendants in the tree of attributes the corresponding utility function f defines the mapping according to equation:

$$f: X_1 \times X_2 \times \dots \times X_n \rightarrow Y$$

3 When a whole is greater than the sum of its parts, it is considered a complex system. Traditional thinking would analyze each individual component, but this method also includes the *relationships* between all components. By studying how the parts of a system relate to each other, we can predict the likelihood of certain outcomes.

4 DEXi is a computer program for multi-attribute decision making - <https://kt.ijs.si/MarkoBohanec/dexi.html>

And each decision rule can be interpreted as an *if-then* rule of the form:

if $X_1 = \text{value } 1$ and $X_2 = \text{value } 2 \dots X_n = \text{value } n$ then $Y = \text{attribute (or value interval)}$

Problems of this kind can be found in almost any field of human activity. They range from everyday personal decisions to more complex problems like selection of the most appropriate technology, project management and planning and many others. Alternatives are ranked according to utility values, where a higher value means a better alternative. In multi-attribute terms, the decision problem is therefore described by:

1. a set of alternatives $A = \{A_1, A_2, \dots, A_n\}$;
2. a set of criteria $X = \{X_1, X_2, \dots, X_n\}$; each criterion $X_i \in X$ is further described by its name, x_i , and the domain D_i of values it may hold;
3. partial utility functions $f_i: D_i \rightarrow R_i, i = 1, 2, \dots, n$;
4. a global utility (aggregation) function $F: R_1 \times R_2 \times \dots \times R_n \rightarrow R$.

Summing-up

In complex systems, there is not just one single scientific truth, just as there is not just one, unified science. Even from a rough division of science, one can see that a wide variety of experts participate in the interpretation of the truth, who can all have very different views on the same problem, since they observe it from different angles. For example, if we consider the Covid pandemic from the perspective of medicine (as a natural science) or from the perspective of sociology (as a social science), we arrive at different scientific truths. In the case of complex systems, however, we must always look for some generalized truth, which is not really anyone's entire truth, but it can be the lowest common denominator (which we are all able to live with). Therefore, in complex systems, the scientific truth is always a kind of generalized truth that has no simple answers. If someone preaches the truth in a simple way, such truth is definitely doubtful. To illustrate, let us borrow the words of some of the most eminent scientists in the field of quantum mechanics:

- *If you are not completely confused by quantum mechanics, you do not understand it.* (John Wheeler)
- *It is safe to say that nobody understands quantum mechanics.* (Richard Feynman)

In these two quotes lies the whole story of truth and science, and the Socratic paradox is made patently clear.

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ADDRESSING PRE-SERVICE TEACHERS' MISCONCEPTIONS AND PROMOTING CONCEPTUAL UNDERSTANDING THROUGH THE CONCEPTUAL CHANGE MODEL

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Abstract

Teaching science concepts for conceptual understanding has its challenges. Bringing about conceptual change in the science classroom can be difficult because most concepts are complicated and often counter-intuitive in the teaching and learning of science concepts. A review of the literature indicates that the conceptual change model, CCM can be an effective teaching technique in addressing misconceptions and improving conceptual understanding when it comes to science instruction. The aim of this research was to find out the effect of the conceptual change model on pre-service teachers' conceptual understanding regarding the topic of forces and motion. Using data from tests and questionnaires, the research questions were answered by quantitatively analyzing the collected data. The analysis revealed that there is a statistically significant correlation between the conceptual change model and the conceptual understanding of the pre-service teacher participants. Overall, the results provide evidence in support of the effectiveness of the conceptual change model, CCM in addressing misconceptions and promoting conceptual understanding of forces and motion among the pre-service teacher participants that volunteered for this research. The results also indicate that the CCM is a teaching model which must be considered by science educators and teachers as they seek to address issues related to misconceptions and conceptual understanding in the teaching of science topics.

Keywords: *conceptual change, conceptual change model, conceptual understanding, misconceptions, pre-service teachers, science education*

Introduction

The authors hold the view that one of the major objectives of science education is to teach students in a way that enables them to organize facts and ideas meaningfully so that they can challenge the erroneous conceptions that hinder their deep understanding of science concepts. Science teaching and learning are often framed as building educational environments that permit students to create knowledge through active scientific investigation and evaluation of experimental evidence (Decristan et al., 2015). However, teaching science concepts effectively has its challenges, such as how to address students' misconceptions as well as stimulate students' interest in learning science (Mansor et al., 2010). Bringing about conceptual change in the science classroom can be difficult because most concepts are complicated and often counterintuitive. Nonetheless, conceptual change is central to science teaching and learning, hence science educators and researchers must endeavor to use educational models that would help promote conceptual change (Nadelson et al., 2018).

The quest to address students' misconceptions and promote their understanding of science has seen the United States educational system undergo a series of unending reforms in the past decades. Transnational assessments such as the Trends in International Mathematics and Science Study (TIMSS) persistently place U.S. students' achievement behind that of students in other technologically developed peer-nations notwithstanding the numerous initiatives undertaken at the K-12 level of American education (Lavery, 2015). It is worth noting that TIMSS and other national assessment programs such as the National Assessment of Educational Progress (NAEP), mostly provide analysis of students' correct responses but do not report on the inaccurate ideas or misconceptions students exhibit in their test answers. Hence, these assessments make it difficult to diagnose students' misconceptions about the science topics they were tested on.

The American Association for the Advancement of Science (AAAS) in its quest to fill the gap referred to earlier, developed an extensive list of assessment items to assess the ideas of middle and high school students across the United States on a wide range of science topics. The test questions provide a picture of what students know and the misconceptions they have about specific science concepts (AAAS Project 2061, 2011). The information from the multiple-choice items included on the AAAS Science Assessment provides teachers the opportunity to diagnose students' misconceptions about the science concepts taught in a classroom.

Addressing misconceptions and building conceptual understanding is vital in science education in terms of promoting scientific literacy. Misconceptions about scientific concepts are due to intuitive thinking, everyday life experiences, and ineffective science teaching (Nadelson et al., 2018). Thus, telling students that their understandings are inaccurate will not lead to conceptual change. Teaching for conceptual understanding requires a constructivist approach whereby students take an active role in the construction of knowledge (Boshuizen et al., 2020).

What can be done to increase students' understanding of science concepts, promote their scientific literacy and improve achievement in national and international assessments? Amid all these reform efforts, the teacher has been identified as a fundamental factor affecting student learning. The benchmarks for teacher certification and pre-service training have all been incorporated into reform models that seek to improve the achievement of students in the United States as far as international assessments are concerned (Lavery, 2015). The above statement gives further credence to the widely held notion that teachers are a major deciding factor in student achievement; therefore, what educational techniques would lead to students' conceptual understanding of scientific concepts? Conceptual understanding is a critical intention when learning abstract concepts and is primarily relevant in science education because it is required in making sense of phenomena. It's the opposite; conceptual misunderstanding involves conceptions that are "wrong and flawed" (Phanphech et al., 2019), which emanate from misconceptions.

The subject of Physics was one of the first areas in which students' prior educational conceptions were studied (Aretz et al., 2016) the Big Bang, being an important subdomain in cosmology, marks the very beginning of space and time. Therefore, it has formed the modern scientific worldview. Transferring this to students through science teaching is a frequent request in science literacy discussion (e.g., American Association for the Advancement of Science, 1993; Schecker et al., 2004). If the instruction does not consider students' pre-educational conceptions, it will be almost ineffective (Anggoro et al., 2019; Bigozzi et al., 2018). Regarding the topic of force and motion, previous studies have established that common-sense explanations for Newtonian concepts are prevalent among students, hence the advocacy for radical instruction aim at reducing such misconceptions and building conceptual understanding (Bigozzi et al., 2018).

In their research that examined student misconceptions about forces and motion, Liu and Fang (2016) found out that although these misconceptions were termed differently in different

papers, there were some common features. With regards to force, the misconceptions were related to a lack of comprehension of Newton's laws of motion and student learning difficulties in grasping the properties of force itself. Some studies have also indicated that several high school physics teachers are unable to identify the passive force exerted on an object placed on a table (Liu & Fang, 2016). In some instances, students erroneously claim that a moving object has a continuous force acting upon it, despite instruction on Newton's First Law of Motion, informing them of the contrary; a classic case of students' inability to apply what has been learned in the classroom to real-world situations due to misconceptions (Chen & Techawitthayachinda, 2021; Demirbas, 2014).

Research shows that the conceptual change model can be an effective teaching model in addressing misconceptions and improving conceptual understanding when it comes to science instruction (Duit & Treagust, 2012; Potvin et al, 2020; Stepan, 2008; Vosniadou, 2013). Two recent studies on student misconceptions and conceptual understanding made a positive case for the conceptual change model as being amongst the most suitable educational techniques for helping students experience conceptual change during science instruction (Kural & Kocakulah, 2016; Nadelson et al., 2018).

Conceptual understanding entails equipping students with the requisite skills to enable them to develop the ability to deeply understand and transfer knowledge gained in a topic, build on it and become creative with knowledge in a relevant way (Tan et al., 2020). Conceptual understanding of science concepts is the ability of students to apply learned scientific concepts to phenomena in an everyday life and how the change in conception is influenced by individuals' real-life experiences (Schwartz & Burrows, 2021). This comprises students' aptitude to recognize new information, build explanations and draw linkages between what they learn and relevant phenomena (Widiyatmoko & Shimizu, 2018).

Research Problem

In this research, the six-phase teaching model referred to as Conceptual Change Model (CCM) was used in teaching a cohort of pre-service elementary school (from kindergarten, grade K to grade 5) teachers. The research was based on a series of teaching and learning activities designed to teach pre-service teachers the topic of forces and motion. This research examined the effect the conceptual change model had on pre-service teachers' conceptual understanding of forces and motion.

In their article on 'Students Conceptions and Conceptual Change' published in the 'Handbook on Science Education, Volume II', Amin et al. pointed out that, the process of conceptual change consists of processes that are "internal to individual learners' minds and interactions with more knowledgeable individuals and peers". They proposed that future research should undertake the task of "improving our understanding" regarding the intricacy of stimulating conceptual change in the teaching and learning environment (Lederman & Abell, 2014, p. 77). It is this gap, that influenced the undertaking of this research.

Research Aim and Research Questions

The purpose of this research was to ascertain the effect of the conceptual change model on pre-service teachers' conceptual understanding of forces and motion. In addition, this research sought to improve the understanding of the science education community on how the various phases of the conceptual change model contribute to the conceptual change process. The questions that guided this research are:

1. What is the effect of the conceptual change model on pre-service teachers' conceptual understanding of forces and motion?

2. In what ways did the conceptual change model address pre-service teachers' misconceptions about forces and motion?
3. How do the various phases of the conceptual change model affect pre-service teachers' conceptual change?

The first research question addressed the effect of CCM on pre-service teachers' "conceptual understanding" of the scientific concept of forces and motion. Question one was answered using analyzed pre and post-test data as well as items from the questionnaires.

The second research question focused on how the CCM tackled misconceptions about forces and motion. Data from Likert scale items were used to answer this question. The third research dealt with the relevance of the various phases employed in the CCM to participants' conceptual understanding.

Research Methodology

General Background

Data collection for this research was done using pre-and post-questionnaires, pre-and post-tests about misconceptions on forces and motion, and a Likert scale questionnaire to measure the linkage between the conceptual change model, CCM, and their conceptual understanding. The 5-point on the Likert scale on pre-and post-questionnaire was designed to elicit participants' conceptions of forces and motion. The conductors of this research used quantitative methodology to answer all the research questions. The participants in this research had similar educational and socio-economic backgrounds, having comparable educational backgrounds, it can be posited that they had almost similar experiences in the learning of forces and motion. The CCM was the foundational teaching technique employed in the elementary physical science course used for this research. The theoretical framework of constructivism was the underlying theory in the conduction of this research and also in the engagement with the pre-service teacher participants during the teaching and learning of forces and motion. Thus, the participants had the liberty to explore the concepts and construct their particular understanding of the topic through personal discoveries (Deliberto, 2014). This research was conducted in the Fall of 2021, it wanted to find out the effect teaching forces and motion using the CCM will have on participants' conceptual understanding, and also contribute to the literature on science teaching and conceptual understanding.

Sample

The sample for this research consisted of 52 pre-service teacher participants enrolled in the elementary physical science course, 42 females and 10 males. The first author led the data collection and invited the participants to volunteer for the research. Participants were told that their participation was voluntary, and they permitted all research instruments and written work to be used for research and writing purposes. All the participating pre-service teachers were undergraduates (mostly sophomores and juniors) and the majority were non-science majors. Everyone in the course was invited to participate, but the sampling approach was purposive; this required that the participants met certain criteria to be able to partake in the research (Huck, 2012). The inclusion criteria were that a potential participant must be a pre-service teacher enrolled in the elementary physical science course, and all enrolled students qualified to volunteer for this research. However, since participation was voluntary some potential participants decided against participation, and they were within their rights to decline. The authors obtained the institution's IRB approval. Informed consent was obtained from all participants whose data was used for this research. The data collection was based on a 3 weeks' course module on the topic of forces and motion.

Instrument and Procedures

The collection of data was done using a one-group 10 questions pre- and post-test (see Appendix A) on participants' forces and motion knowledge. 5-point Likert scale questionnaire (from strongly disagree to strongly agree) to measure participants' linkage between the CCM and their conceptual understanding (see Appendix B). Also, included in the data collection instruments is a questionnaire on the effects of the phases of CCM on conceptual change (see Appendix C) in addition to a pre- and post-questionnaire on participants' conceptions of forces and motion (see Appendix D), both questionnaires are based on a 5-point Likert scale (from strongly disagree to strongly agree).

Before the commencement of the 3-week module on the topic of forces and motion, the participants were given a pre-test that consisted of 10 questions to measure their knowledge of forces and motion. The pre- and post-test questions are designed using the AAAS project 2061 Science Assessment website test questions to test students' ideas about forces and motion. The test questions were intended to help participants demonstrate accurate knowledge of forces and motion, and analyze the reasons why a scientific claim might be true or not. The questions on the test and items in the questionnaire also include well-known misconceptions such as wrong answer choices so that they can be used for analysis and data interpretation. Using this approach had the advantage of directing students' attention to the particular misconceptions that needed to be addressed.

The educational session that was used for data collection commenced with a phenomenon-based learning approach where a "phenomenon," (air-blowing ping-pong activity) was used to hook students into the lesson. At the end of the air-blowing ping-pong activity, participants came up with an investigative activity to find out the effect a constant force would have on the velocity and acceleration of four different types of balls (rubber ball, styrofoam ball, steel ball, and golf ball). The constant force was provided by a pull-back toy car. Participants wrote down their initial predictions and explanations per the CCM teaching phases. Students held group discussions about their predictions and explanation before, during, and after the activity.

The class on forces and motion was a process of looping back and forth with the CCM's six phases. The process was when the instructor as participants came with new questions that they would like to seek an answer to beyond the scope of the current lesson.

The post-test and post-questionnaire on the connections between the CCM and conceptual understanding were administered. Also, another questionnaire was completed on the effect of the various phases of CCM on participants' conceptual change

Figure 1

Pull-back Car Being Used to Apply Force to Steel and Golf Balls



Data Analysis

The data from the pre- and post-tests as well as the questionnaires were coded in an Excel Spreadsheet and imported into the SPSS statistical software for quantitative analysis. The pre- and post-tests were graded by the author out of a total score of 10. The test scores were analyzed using a paired-samples *t*-test statistical model to check if there was a statistically significant difference between the means of the pre and post-tests. The data from the questionnaire was also analyzed using a Pearson bivariate correlation in SPSS to find out if there was a relationship between participants' conceptual understanding forces and motion and the conceptual change model (CCM). In addition, another paired-samples *t*-test was conducted on the pre and post questionnaire data.

Research Results

A bivariate (Pearson) correlation (Field, 2018) was run in SPSS to see if there is a significant correlation between the conceptual change model (CCM) and conceptual understanding of the topic of forces and motion. The results showed that the significant value (*p*-value), $p < .001$ is below the standard criterion of .05, indicating that there is a statistically significant positive linear correlation between CCM and building conceptual understanding. Table 1 summarizes the bivariate correlation between the two variables. The CCM moderately correlated with building conceptual understanding; Pearson's $r = 0.646$, this correlation is significant at the .01 level.

Table 1
Correlation Results for Conceptual Change Model and Conceptual Understanding

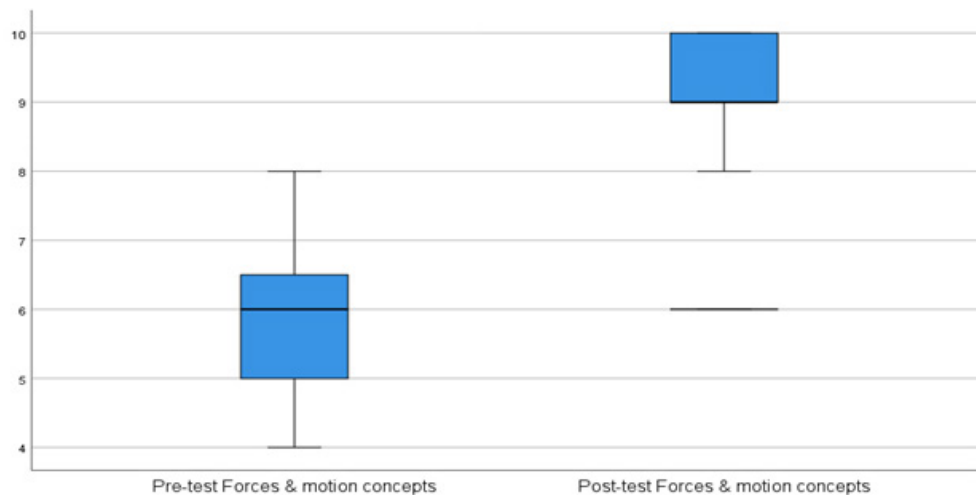
Variables		Conceptual Change Model	Conceptual Understanding
Conceptual Change Model	Pearson's <i>r</i>	1	0.646**
	<i>p</i> -value	-	< .001
	<i>N</i>	52	52
Conceptual Understanding	Pearson's <i>r</i>	0.646**	1
	<i>p</i> -value	< .001	-
	<i>N</i>	52	52

**Correlation is significant at the .01 level (2-tailed)

A paired-sample *t*-test (Field, 2018) was conducted to compare pretest and posttest scores ($n=52$) on pre-service teachers' understanding of some concepts on forces and motion. Results point to a statistically significant difference between pretest scores ($M = 5.75$, $SD = 1.118$) and posttest scores ($M = 9.06$, $SD = .873$); $t(51) = -19.93$, $p < .001$. Effect size (*d*) was calculated to examine the magnitude of difference between the average score of both tests. Cohen's *d* effect size was 1.197.

Figure 2

Boxplot Showing the Means of the Conceptual Change Model and Conceptual Understanding



On participants' conceptions of the concept of forces and motion, there was a statistically significant difference between the pre- and post-questionnaire responses on all items. Tables 2 and 3 below provide a summary of the descriptive statistics and paired sample *t*-test results. The results indicate that using the CCM for teaching the topic had a positive effect on pre-service teachers' misconceptions about forces and motion. Participants' response for the item, "The constant motion of a pull-back car requires a constant push or pull", $t(51) = 20.935$, $p < .001$, $M(\text{difference}) = 1.94$ between the pre- and post- responses, with a Cohen's $d = .669$, suggesting a moderate to high effect size. On the second questionnaire item, "If a ping-pong ball is not moving then there is no force acting on it", $t(51) = 15.803$, $p < 0.001$, $M(\text{difference}) = 1.83$ with a Cohen's $d = 0.834$, suggesting a high effect size and practical significance. The results for the third questionnaire item, "A golf ball stops moving because the applied force is finished", $t(51) = 17.062$, $p < 0.001$, $M(\text{difference}) = 1.92$ with a Cohen's $d = 0.813$, suggesting a high practical significance. Regarding the item, "An object can only move at constant speed if a force is pushing or pulling it", $t(51) = 21.974$, $p < 0.001$, $M(\text{difference}) = 2.08$ with a Cohen's $d = 0.682$, suggesting a moderate to high effect size.

Table 2

Descriptive Statistics of Pre- and Post-Tests on Conceptions of Forces and Motion

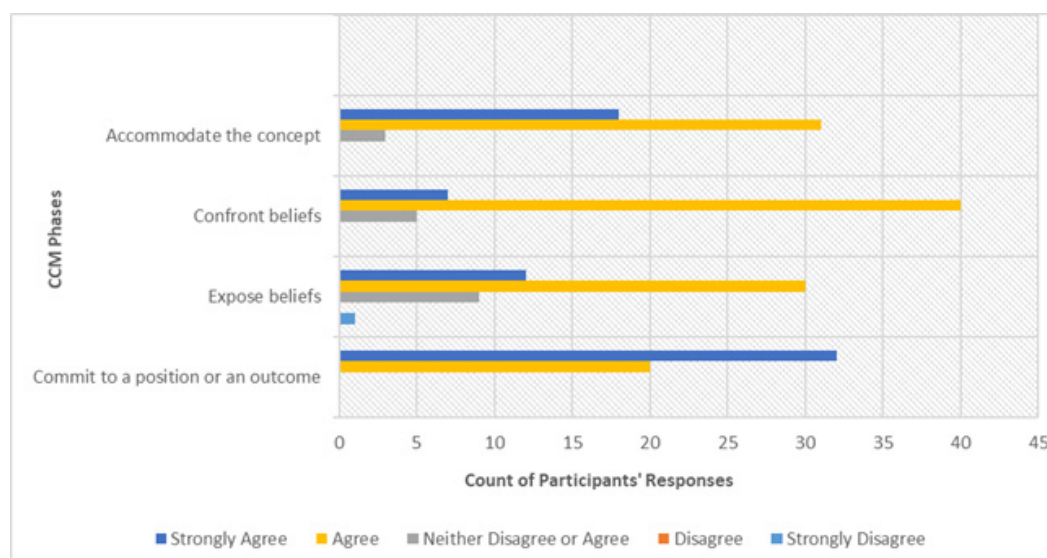
	N	Pre-Test		Post-Test	
		M	SD	M	SD
The constant motion of a pull-back car requires a constant push or pull.	52	3.71	.536	1.77	.546
If a ping-pong ball is not moving, then there is no force acting on it	52	3.52	.828	1.69	.466
A golf ball stops moving because the applied force is finished	52	3.67	.474	1.75	.556
An object can only move at constant speed if a force is pushing or pulling it	52	3.77	.546	1.69	.065

Table 3
Paired Samples Statistics of Items on Conceptions of Forces and Motion

	<i>t</i> -test	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
The constant motion of a pull-back car requires a constant push or pull.	20.935	51	<.001	0.669
If a ping-pong ball is not moving, then there is no force acting on it	15.803	51	<.001	0.834
A golf ball stops moving because the applied force is finished	17.062	51	<.001	0.813
An object can only move at constant speed if a force is pushing or pulling it	21.974	51	<.001	0.682

The descriptive statistics carried out on participants' responses to how the various phases of the conceptual change model affected their conceptual change showed that the pre-service teachers perceived the "Confront beliefs" and "Accommodate the concept" phases to have had the most positive effect on their conceptual change. The mean values for the "Commit to a position or an outcome" and "Expose beliefs" phases are 3.08 and 3.13 respectively, indicating that participants believe that they had no significant effect on their conceptual change. However, the mean values for the "Confront beliefs" and "Accommodate the concept" phases are 4.31 and 4.48 respectively. The bar graph shown in figure 4 provides the graphical interpretation of their responses.

Figure 3
Phases of the CCM and their Effect on Pre-Service Teachers' Conceptual Change



Discussion

The results are discussed in relation to this research and other research in the literature, as well as its implications for science education, are pointed out, and possible areas for future research are proposed. Misconceptions and lack of conceptual understanding are major

obstacles to teaching science and improving scientific literacy across the educational spectrum. Therefore, the teaching and learning of science concepts for concrete understanding and minimization of misconceptions require a conceptual change model to make the educational process more meaningful. This research set out to investigate the effect of the CCM on pre-service teacher participants' conceptual understanding and misconceptions about forces and motion. Generally, the results showed that the pre-service teacher participants in this research experienced conceptual change and gained conceptual understanding as well as minimized their misconceptions concerning the topic of forces and motion. The educational process which involved an investigative activity to find out the effect of a push and pull force on the motion of different types of balls was carried out using the conceptual change model, addressed pre-service teachers' conceptual understanding, and reduced their misconceptions about the concept of forces and motion.

Results in this research not only confirm what is generally known about the positive effect of the conceptual change model in addressing misconceptions and improving conceptual understanding but also advance our understanding of the importance of the conceptual change model (CCM) for conceptual change. The six CCM steps referred to in earlier sections of this write-up illustrate the model as a student-centered learning method. This technique appreciates students' independence to construct their own knowledge (Aydin, 2015; Ayaz, 2015). This self-directed learning approach provides students the openness and confidence to share their ideas with peers and teachers, thus encouraging them to take responsibility for their learning. Such impetus creates the opportunity for conception change when the evidence shows that their views are misconceptions. This approach complemented by peer discussions nurtures students' self-reliance in accepting a scientifically accurate conception as opposed to holding on to pre-teaching misconceptions (Madu & Orji, 2015).

In answering the first research question, the analysis indicated that there was a positive correlation between pre-service teachers' conceptual understanding of forces and motion and the conceptual change model of teaching. Congruent with other results in the literature (Nadelson et al., 2018; Potvin et al., 2020), the results of this research also showed that teaching with the conceptual change model increased conceptual understanding and minimized misconceptions (Akbaş & Gençtürk, 2011; Heddy et al., 2018). However, most of the research available in the literature has been done with students in kindergarten to high school settings (Amponsah & Ochonogor, 2018; Ekon & Edem, 2018; Gates, 2010; McLure et. al., 2020; Santyasa et al., 2018) or on students enrolled in science-major programs at the university (Arthurs, 2019; Arthurs et. al., 2021). Our research results extend the literature by reporting on pre-service teachers' learning force and motion through the conceptual change model. This research is different from the work of Anggoro et al., (2019), though their results showed that the teaching model had improved the conception of the pre-service teacher participants after instruction they used the multimedia visual reflective conceptual change model (RCCM). Although they reported improvements in participants' conceptual knowledge of force and motion, their sub-topic was on free fall whiles this research was based on pushes and pull. Also, the results of this research were based solely on quantitative data whiles Anggoro et al., (2019) conducted their research by using a mixed-methods design.

In connection with research question two, the differences in pre- and post-test scores may be attributed to several reasons. To begin with, the low mean score on the pre-test could be due to the participants' lack of exposure to the science concept knowledge being tested. Though almost all the participants had studied forces and motion at various levels of their education, their understanding of forces and motion concepts had not been tested in such a manner. Furthermore, the method used in teaching the lesson by the instructor placed the pre-service teacher participants in an environment that emboldened them to question their conceptions and work toward resolution and conceptual change just as Koponen, (2014) had surmised in their

paper. The resultant effect is the comparatively high post-test mean score. The results on the effect of the various phases of the CCM process that facilitated the most conceptual change amongst participants showed peer-to-peer discussions and sharing of ideas provided the most opportunities for students to develop conceptual understanding.

In the pre- and post-questionnaire responses on participants' conceptions about the concept of forces and motion, there was a statistically significant difference between pre- and post-responses on all items. All the items on the questionnaire were designed to test pre-service teachers' misconceptions about forces and motion. The descriptive statistics carried out to help answer research question three showed that the pre-service teachers believed the "Confront beliefs" and "Accommodate the concept" phases to have had the most positive effect on their conceptual change. The four items in the questionnaire on the effects of the phases of CCM on conceptual change produced different responses as can be seen in figure 4. This is indicative that the different phases of the CCM had an unequal effect on preservice teacher participants' conceptual change. This result is in agreement with proponents of using multi-phase educational approaches to prop up conceptual understanding in the teaching and learning of science (Duit & Treagust, 2012; McLure et al., 2020). In agreement with other results in the literature (Duit & Treagust, 2012; Santyasa et al., 2018), the results of our research also showed that using the conceptual change model in teaching science concepts promotes conceptual understanding and minimizes faulty prior conceptions.

Overall, this research in addition to confirming the importance of the conceptual change model, CCM in promoting conceptual understanding, conceptual change, and reducing misconceptions in learning science concepts; also discovered that the six phases of the Conceptual Change Model have different effects on conceptual change.

The implications of this research for science education are numerous. Regarding the theoretical implication, the theory of conceptual change in science education must be developed and propagated to ensure that it doesn't remain the preserve of psychology or cognitive science research. The methodological implication is that the CCM technique of instruction should be employed in more science classrooms across the K-20 educational spectrum to improve its visibility in science education research. The practical implication is that peer-peer collaborative discussions should be promoted and encouraged in the science classroom. As evident from the results, conceptual change and understanding of science concepts are most successful in student-centered collaborative learning environments. The current practice of top-down, teacher-centered, and question-answer approaches to science learning should be discouraged. In its place should be leveraging the advantages of group discussions and student-student collaborations (Kilinc et al., 2017). In the context of real-world application, this research banks on a strong groundwork of teaching concepts while developing enhanced learning experiences for K-12 students, investigates the challenge of student engagement and content learning in STEM coursework (Burrows et al., 2013).

Since data collection and analysis were based on a quantitative approach, we couldn't elicit participants' responses in terms of how their conceptual change was influenced by the "Confront beliefs" and "Accommodate the concept" phases. Future research should use a mixed-methods approach to explore participants' thoughts about these phases affecting their conceptual change and understanding of forces and motion. Research that is qualitatively designed or includes qualitative components would give more information about the role the various phases play in participants' conceptual change process during classroom instruction. These activities would be beneficial for teachers, educators, and curriculum designers in terms of how CCM instruction can be developed for use in science classrooms. In addition, the merit of the conceptual change model for conceptual change and understanding should be investigated and researched across multiple science topics and concepts with the wide-ranging perspective of promoting lifelong science learning and literacy. The results of this research, also contribute to

the literature on effective educational practices that can inform the design and implementation of conceptual change teaching practices within teacher education programs. This research has a couple of limitations. To begin with, the limited number of participants. Even though the participants developed deep knowledge about the topic of forces and motion, increasing the number of participants can reinforce the generalization of the results. The other limitation is the deficiency of in-depth interviews of participants to get their views on the specific effects of the phases of the CCM and how they would implement it in their future classrooms. Hence, future research that explores a mixed-methods approach should be done.

Conclusions

This research provides evidence in support of the effect of the CCM in promoting conceptual understanding of forces and motion among pre-service teachers enrolled in the elementary physical science course. The results showed that the CCM is a teaching model which must be considered by science educators and teachers when dealing with issues related to misconceptions and conceptual understanding of science topics. The theoretical value of the conceptual change model in terms of facilitating conceptual change and minimizing misconceptions was empirically tested in this research. Furthermore, the results of this research help connect theory and practice and offer empirical support for the knowledge assimilation perspective of conceptual change by showing that participants developed more conceptual understanding when their misconceptions and alternative ideas were engaged during instruction. The result of this research makes a good case for why it is essential for science teachers and educators must use the CCM in science teaching and learning.

This research submits that using the conceptual change model is a favorable approach to developing pre-service teachers' conceptual understanding and knowledge of science content, particularly when incorporated with the teaching of pedagogy. The evidence further suggests that the conceptual change model or phases of it has applicability and utility in teaching science topics related to the forces and motion sub-topic of pushes and pulls. The question then is, why does this research matter? This takes us to the essence of this research, the desire for science educators and teachers to create an educational experience for students that causes them to change their wrong prior notions based on the experience of teaching and classroom interaction with peers. The experiences of students in the teaching and learning process influence their understanding, and this is a tenet into which the conceptual change model taps to develop conceptual understanding. This research shows that pre-service teachers can change their wrong ideas about science concepts when they learn under the experiential conditions that the conceptual model creates. The objective going forward is to conduct research on the concrete processes that facilitate conceptual change by interviewing participants who experience the phenomenon of learning using the conceptual change model.

Declaration of Interest

The authors declare no competing interest.

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Appendix A: Pre and Post-Test on Forces and Motion

This test is being administered to pre-service teachers enrolled in the Elementary School Physical Sciences Course, EDEL 1440. The primary objective of this test is to assess pre-service teachers' knowledge of

forces and motion required for teaching elementary grade physical science curricula at schools. Please, know that you are under **no** obligation to complete this survey. You can decide to **not** complete it and it would **not** affect you in any way as far as the EDEL 1440 Course is concerned.

Modified questions from the AAAS Project 2061

Kindly answer the following questions to the best of your understanding.

1. Is it possible for an object to move at constant speed without a force pulling or pushing it?
 - A. No, a constant force is needed to keep an object moving at constant speed.
 - B. No, a force is needed to keep an object moving at constant speed, but it doesn't have to be a constant force.
 - C. Yes, an object will move at constant speed unless a force acts to change its motion.
 - D. Yes, an object will move at constant speed as long as the force inside the object doesn't run out.
2. What will happen to an object that is moving forward if a force pushing it backward is greater than the force pushing it forward?
 - A. The object will move at constant speed for a while and then slow down and stop.
 - B. The object will slow down for a while and then move at a slower constant speed.
 - C. The object will slow down, stop, and then begin to move faster and faster in the opposite direction.
 - D. The object will slow down, stop, and then begin to move at a constant speed in the opposite direction.
3. What is the net force on a 200g ball when it hits a wall with an acceleration of 10 m/s²?
 - A. 4 N
 - B. 3 N
 - C. 2 N
 - D. 1 N
4. A flying Frisbee stops because it has run out of force. True/false. Explain.
5. While you're slowly lifting a book straight upwards at a constant speed, the upward push of your hand on the book is:
 - A. greater than the downward pull of gravity on the book.
 - B. equal to the downward pull of gravity on the book.
 - C. smaller than the downward pull of gravity on the book.
 - D. equal to the sum of the book's weight and the pull of gravity on the book.
 - E. the only push or pull on the book.
6. Your friend pushes a sofa with a constant horizontal force, so that it moves down your school hallway at a constant speed. The force that she applies is:
 - A. the same as the weight of the sofa.
 - B. greater than the weight of the sofa.
 - C. the same as the total friction forces that resist the sofa's motion.
 - D. greater than the weight of the sofa plus total friction forces that resist the sofa's motion.
 - E. greater than the total friction forces that resist the sofa's motion
7. If you apply a net force of 3 N on a 100g box, what is the acceleration of the box
 - A. 10 m/s²
 - B. 30 m/s²
 - C. 20 m/s²
 - D. 5 m/s²
8. A person pushes a box across the floor. There are two horizontal forces on the box: the force of the push, and the force of friction. The force of friction is in the opposite direction to the box's motion. The speed of the box is increasing. Which of these statements *must* be true?

- A. The force of the push is stronger than the force of friction.
B. The force of the push is the same strength as the force of friction.
C. The force of the push is strong.
D. The force of friction is weak.
9. Is force required to keep an object moving? Explain your answer.
.....
10. A moving golf ball has a force within it that keeps it moving.
A. True because it has a force acting on it to push or pull it in motion.
B. False because a force acts on an object to keep it moving, the force is not within it.
C. Neither true nor false.
D. Partially true.

Appendix B: Questionnaire on CCM and Conceptual Understanding of Forces and motion

Conceptual Change Model

Item	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
The teaching approach helped me understand the concept of forces and motion.	☐	☐	☐	☐	☐
Recording the reasons for my ideas dispelled some misconceptions I had.	☐	☐	☐	☐	☐
The peer-to-peer group discussions convinced me to abandon some preconceptions I had.	☐	☐	☐	☐	☐
I was able to see applications of the concept of forces and motion beyond the lesson for the day	☐	☐	☐	☐	☐

Please, indicate how strongly you agree or disagree with the following statements

Conceptual Understanding

Item	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
Force is required to keep an object moving.	☐	☐	☐	☐	☐
Constant motion requires a constant push or pull.	☐	☐	☐	☐	☐
A stationary object has no force acting on it.	☐	☐	☐	☐	☐
A moving object will stop when it runs out of force.	☐	☐	☐	☐	☐

Appendix C: Questionnaire on the Effects of the Phases of CCM on Conceptual Change

Please, indicate how strongly you agree or disagree with the following statements

Item	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
Writing down my predictions and explanations helped build my understanding of forces and motion.	☐	☐	☐	☐	☐
Conducting the investigative activity and working with measured data helped me change my initial ideas	☐	☐	☐	☐	☐
The discussions, debates and arguments using collected data had a positive effect on my understanding of the concept of forces and motion	☐	☐	☐	☐	☐
Sharing my ideas, predictions and explanations with group members enhanced my understanding of forces and motion.	☐	☐	☐	☐	☐

Appendix D: Pre and Post Questionnaire on Conceptions of Forces and motion

Item	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
The constant motion of a pull-back car requires a constant push or pull.	☐	☐	☐	☐	☐
If a ping-pong ball is not moving, then there is no force acting on it.	☐	☐	☐	☐	☐
A golf ball stops moving because the applied force is finished.	☐	☐	☐	☐	☐
An object can only move at constant speed if a force is pushing or pulling it	☐	☐	☐	☐	☐

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THE RELATIONSHIP BETWEEN CLASSROOM MANAGEMENT JUSTICE AND SCHOOL ENGAGEMENT FROM THE PERSPECTIVE OF UNIVERSITY STUDENTS

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Abstract

Education continues to be an area that is likely to completely affect the future of humanity. Countries are trying to raise the level of education and increase the quality of the education provided as much as possible. To ensure that the quality of education is improved, many studies look from the perspectives of educators and officials who determine education policies. This study examines teachers' classroom management and approaches to justice in the classroom through the eyes of students. This study aims to shed light on the relationship between educators' justice in classroom management and students' school engagement based on the perceptions of university students. The study is based on a correlational design that examines the relationship between variables. It was conducted with 283 students at Şırnak University. The sample was determined randomly. The data were collected via the "Perception of Justice in Classroom Management" scale and the "School Engagement of University Students" scale. As a result, there was a moderately positive and significant relationship between the perception of justice in classroom management and school engagement. Besides, as a result of the regression analysis, it was revealed that the perception of the educators towards justice in classroom management predicted students' school engagement. It was observed that 19% of students' school engagement was explained by educators' perceptions of justice in classroom management.

Keywords: classroom management, correlation, perception of justice, school engagement, university students

Introduction

Justice is one of the issues that is quite common and demanded to a great extent by human beings. Justice is on some occasions represented as equality, the most appropriate decision for a particular case, or affirmative action for disadvantaged individuals. The term justice is defined variously in different cases (Özgenel & Bozkurt, 2019). The conceptual and lexical meaning of justice is "to ensure that every single person uses the rights owned by the law, comply with the right and the law, look after one's rights" (Türk Dil Kurumu [TDK], 2022). As it can be understood from this definition, justice stipulates that every individual acquires his/her right or complies with the law. Since classrooms are settings in which collective education is provided as part of educational organizations, it is essential to protect the right and ensure justice there. Accordingly, teachers, the head of classrooms, are expected to respect the rights of students, protect their law, and refrain from discrimination and injustice. Students carefully monitor

their teachers' behaviour in the classroom and evaluate whether they provide justice or not. Educational organizations should be handled much more separately from other organizations as their mission is to prepare future generations for life (Küçükçene & Aydoğan, 2018). The fairness of teachers in classroom management may affect students in different ways, one of which is school engagement. Considering the different positive effects of school engagement, in particular student achievement, it is important and necessary to examine the relationship between justice in classroom management and school engagement (Salmela-Aro et al., 2009). In addition, it is very important for the teacher, who is seen as a role model in the classroom, to ensure justice in classroom management, to protect the applicable rights and law as well as to increase success and help form the personality of the students.

Considering the subject of justice in classroom management in terms of its theoretical foundations, it is included in organizational justice. The literature on organizational justice reveals that it generally consists of three dimensions. These are distributive justice, interactional justice, and procedural justice (Folger, 1987; Greenberg & Colquitt, 2005; Meşe & Bayraktar, 2019; Özmen et al., 2007). Distributive justice refers to the fair distribution of the tangible and intangible assets of the organization among employees or service recipients (Foley et al., 2002; Koçak & Bostancı, 2019; Wu & Wang, 2008). Distributive justice occurs when employees or service recipients believe that the organization behaves fairly in the distribution between itself and other employees or service recipients. Interactional justice refers to the perceived fairness of the organization in the interpersonal treatment of its employees (Küçükçene & Aydoğan, 2018; Nural, 2015). A closer relationship with some employees or service recipients while building a more distant relationship with others is interpreted as a disruption of interactional justice. Procedural justice is defined as the fairness of work and procedures in decision-making and implementation processes in organizations (Altıntaş, 2007; Beugre, 2002; Cohen-Charash & Spector, 2001; Niehoff & Moorman, 1993). In order to ensure procedural justice, allocation procedures should be consistently applied across people and over time, ensure that the right decisions and behaviours are taken, be free from prejudice, provide opportunities to modify and reverse incorrect decisions, reflect the concerns of all subgroups and individuals, and be compatible with ethical behaviours and values in all cases (Leventhal et al., 1980). This study takes into account justice in educational organizations and more importantly in classroom management, which makes it different from other studies that focus on general organizational justice since the structure of a classroom is different from the general structure of an organization. Classrooms are not environments where the teacher is the employer, and the students are employees. Considering this difference, reward allocation has been added to the other dimensions of organizational justice in ensuring justice in classroom management.

In classroom management, the teacher is expected to treat students fairly in all aspects (Gökalp, 2021) as all other behaviours of the teacher will be considered suspicious in the eyes of the students if s/he exhibits unfair behaviour witnessed by students (Gündüz, 2004). As a requirement of their pedagogical expertise, teachers use rewards as positive reinforcement to motivate their students or increase their positive behaviours. Reward allocation requires that teachers not discriminate between students or equivalent work when awarding (Cummings, 2000).

Organizational justice, on the other hand, is generally examined in terms of the legal texts of organizations and the behaviour of managers toward employees (Devonish & Greenidge, 2010). The difference between this study and other studies in the literature related to organizational justice is that it focuses on educational organizations as educational organizations are service organizations consisting of teachers and students, unlike commercial organizations consisting of workers and employers. Another different aspect is that the pedagogical reward dimension, which is specific to educational organizations, is also examined within the scope of justice in classroom management.

The fair behaviour of the managers or the perceived justice of the employees towards the managers is associated with organizational citizenship behaviour, trust, commitment, motivation, performance, job satisfaction, leader-member interaction, productivity, burnout, decision making, leadership, conflict, and stress (Giderler Atalay, 2015). Studies have shown that being fair in management has positive consequences for the organization. In the study conducted by Akyol (2013), justice in management increases both the performance of the employees and organizational commitment. Justice in management increases employees' trust in and commitment to the organization as well as productivity in their work (Nural, 2015). However, there is no study found to examine the relationship between university-level students' perceptions of academic staff's justice in classroom management justice and school engagement.

It is thought that the success of students in educational organizations and their successful acquisition of academic and theoretical knowledge and applications for their profession in the future may be associated with school engagement. Studies have shown that individuals are more successful in organizations where they feel connected and with which they identify (Fredericks et al., 2004; Ryan & Patrick, 2001; Willms, 2003). Organizational commitment is defined as one's sense of belonging to and identification with an organization, and voluntary participation in all kinds of activities of that organization (Çelik & Üstüner, 2020; Meyer & Allen, 1996; Joolideh & Yeshodhara, 2009). It is suggested that individuals with low organizational commitment experience alienation from the organization, causing problems in reaching the goals of the organization (Çelik, 2020). When considered specifically in terms of educational organizations, there are some differences as a student is not a service provider but a service recipient. In addition, a student does not receive a fee at school as the only reason for attending school is to receive an education. Therefore, the student's relationship with the school is more liberal than that of the employees.

School engagement occurs when they see themselves as a member of the school feel happy to be a part of that school, identify with the school, and voluntarily work for the school although they do not have any financial gain (Finn & Voekl, 1993; Fredricks et al., 2004). Another definition highlights that student engagement occurs if s/he loves school, builds good friendships at school, feels like a part of the school, and is willing to comply with the rules of school (Libbey, 2004). One may notice that students possessing school engagement wear clothes that bear various symbols showing a sense of belonging to the school, and also carry the tools that bear the school's logo and coat of arms and want to participate in all kinds of school activities. In addition, they avoid dropouts, participate in school activities at a high level, and are successful with high scores in their classes (Karababa et al., 2018). School engagement has been investigated in line with various dimensions, taking into account these behaviours of students.

Students' school engagement is categorized by Fredricks et al. (2004) in three dimensions: cognitive engagement, emotional engagement, and behavioural engagement. A student's cognitive engagement can be expressed as an effort to understand what is being taught (Fredricks et al., 2004). The student's emotional engagement includes emotional reactions such as interest, boredom, happiness, and sadness in the learning environment and attitudes towards school, teachers, and other students (Stipek, 2002). Behavioural engagement refers to observable behaviours such as following the learning process, attending the lesson, listening to the teacher, and making an effort for sports and club activities (Wang & Eccles, 2012). In the literature, there are studies on school engagement.

Most of the studies on school engagement focus on examining the relationship between school engagement and academic success. Some of the studies examining the engagement-achievement relationship revealed that school engagement increased success, while some suggested that there was no positive significant effect (Roorda et al., 2011). In some studies, it is reported that students with school engagement have good social adaptation after school and

have high levels of school attendance and success (Salmela-Aro et al., 2009). Apart from some results, some of the reasons for the student's school engagement have also been the subject of research. In the literature, it is reported that the school climate predicts the student's school engagement and the quality of school life as well as the social and sportive opportunities at school positively affect the student's school engagement (Argon & İsmetoğlu, 2016; Kalaycı & Özdemir, 2013; Özgenel et al., 2018; Tüzel İşeri & Yavuz Tabak, 2019). It is believed that another aspect of students' school engagement is the treatment they are subjected to at school. The behaviours of teachers at school, especially in the classroom, may affect the student's school engagement. For this purpose, this study examines the relationship between teachers' classroom management, students' perceived justice in classroom management, and students' school engagement. Another purpose of examining the issue of justice in classroom management has been to draw attention to the issue in terms of educational organizations and to create more demands for justice in terms of students who receive an education.

Hypotheses

The following hypotheses were tested in this study:

H1: Educators' justice in classroom management is moderate according to the perceptions of university students.

H2: University students have a high level of school engagement.

H3: There is a relationship between educators' justice in classroom management and student engagement according to the perceptions of university students. This relationship is positive and moderate.

H4: According to the perceptions of university students, educators' justice in classroom management predicts school engagement.

Research Methodology

General Background

It is assumed that educators' justice in classroom management is associated with students' school engagement. Thus, it seems appropriate to apply the correlational model to determine the relationship status of these two variables. This model is considered suitable for determining the relationships between two or more variables as well as the direction and size of the relationships (Cohen et al., 2000; Karasar, 2012). The type of research is relational. It examines the relationship between teachers' classroom management justice and students' commitment to school at university. The field application of the research was carried out in December 2021. The research was applied to the students at Şırnak University, regardless of the department they studied. It was applied to students who volunteered to participate in the research. Of the research scales filled out by the students, those that were completely filled and those that did not have a single option selected in all questions were processed. Before starting the research, ethical approval was obtained from the Ethics Committee of Şırnak University dated 03.11.2021 and numbered 2021/104. Ethics committee was assured that no private information would be collected, no private questions would be asked, the data obtained would not be used for other than scientific purposes and would not be disclosed to third parties or institutions, the study would be conducted with voluntary participants, and these rules would be followed throughout the research process.

Sample

The population of the research consists of 4074 students studying at Şırnak University. There was an attempt to reach as many students as possible. Çokluk, Şekercioğlu and Büyüköztürk (2014) stated that the sample size should be 200 or more for complex analyses in studies. In this study, the sample represents the population at 95 percent confidence level (Field, 2009). Students who volunteered to fill in the scales were included in the study. However, some forms were excluded as there were spaces left blank and only one degree of some forms was marked. 283 forms were included as the evaluation forms were filled out completely without uniformity. The gender and grade levels of the students included in the sample are given in Table 1.

Table 1
Demographic Characteristics of the Students Participating in the Sampling

Variables	Sub-dimensions	f	%
Gender	Male	151	53.4
	Female	132	46.6
Grade	1	75	26.5
	2	69	24.4
	3	71	25.1
	4	68	24.0

Measurement Tools

In this study, a form was created to collect data. The form consists of three parts. The first part is aimed at obtaining demographic information such as gender and grade level of university students. The second part includes the "Perception of Justice in Classroom Management" scale, which measures the fairness of educators in classroom management, and the third part includes the "School Engagement of University Students" scale, which measures students' school engagement. Both scales are of 5-point Likert type. The scale of perception of justice in classroom management is rated from Strongly Disagree (1) to Strongly Agree (5), and the scale of school engagement of university students is rated from Never (1) to Always (5). While evaluating the scores given to the scales, arithmetic means were taken as a basis. Ranges and corresponding statements are as follows: 1.00-1.80 "Very low", 1.81-2.60 "Low", 2.61-3.40 "Moderate", 3.41-4.20 "High", and 4.21-5.00 "Very high".

The perception of justice in classroom management scale used in the research was developed by Nural (2015) together with her thesis advisor for the thesis study. The scale consists of 16 items and is 4-dimensional. Dimensions of the scale are interactional justice (5 items), procedural justice (4 items), reward allocation (3 items), and distributive justice (4 items). In the analysis made for the development of the scale, the Cronbach Alpha reliability coefficient (α) was calculated as .85 by Nural (2015). The reliability coefficients of the dimensions of the scale were .76 for interactional justice, .72 for procedural justice, .72 for reward allocation, and .70 for distributive justice. The total variance obtained from the four factors was found to be 56%. In this study, reliability analysis was performed again on the scale and total variance was calculated. According to the analysis made for this study regarding the dimensions of the scale, reliability values were .74 for interactional justice, .73 for procedural justice, .71 for reward allocation, and .79 for distributive justice. The Cronbach Alpha reliability coefficient (α) for the

overall scale was found to be .83. According to this analysis, the total variance obtained from the four factors was 57%.

The scale of school engagement of university students, which was used to measure school engagement in the study, was developed by Gün et al. (2019). The scale consists of 15 items and is 3-dimensional. The dimensions of the scale are behavioural engagement (5 items), emotional engagement (5 items), and cognitive engagement (5 items). In the analysis made for the development of the scale, the Cronbach Alpha reliability coefficient (α) was calculated as .82 by Gün et al. (2019). The reliability coefficients of the dimensions of the scale were .66 for behavioural engagement, .68 for emotional engagement, and .78 for cognitive engagement. In this study, reliability analysis was performed on the scale again. According to the analysis made for this study regarding the dimensions of the scale, the reliability values were .68 for behavioural engagement, .70 for emotional engagement, and .75 for cognitive engagement. The Cronbach Alpha reliability coefficient (α) for the overall scale was found to be .81.

Data Analysis

Before starting the analysis, the normality test was applied to determine the distribution of the collected data. In the test, skewness and kurtosis values were examined to find out that these values ranged between +1 and -1. Since these values showed that the collected data were normally distributed, the analysis was continued. Then, the frequency and percentage values belonging to the genders of the university students participating in the research were calculated. After the gender distribution was determined, the arithmetic means of the scores given by the students to the scales including the perception of justice in classroom management and school engagement of university students, standard deviation values and the highest and lowest values in the scores were calculated. The scales were examined based on these mean scores. After interpreting the mean scores, these two variables were subjected to correlation analysis to examine the relationship between them. After the relationship analysis, regression analysis was conducted to determine whether university students' perceptions of the fairness of university instructors in classroom management predict university students' school engagement.

Research Results

The arithmetic means and standard deviation and standard error values of the data collected to measure the university students' perceptions of the fairness of university instructors in classroom management and their school engagement are given in Table 2.

Table 2

Arithmetic Mean and Standard Deviation and Standard Error Values Regarding Perceptions of Justice in Classroom Management and School Engagement

Variables	Min	Max	$\bar{X}$	SE	SD
Interactional Justice	1.00	5.00	3.72	.06	.75
Procedural Justice	1.00	5.00	3.83	.06	.79
Reward Allocation	1.00	5.00	3.80	.06	.73
Distributive Justice	1.00	5.00	3.81	.06	.81
Justice in Classroom Management	1.00	5.00	3.79	.05	.51
Behavioural Engagement	1.60	5.00	4.11	.04	.64
Emotional Engagement	1.00	5.00	4.06	.06	.67
Cognitive Engagement	1.80	5.00	4.22	.04	.71
School Engagement	1.73	5.00	4.13	.04	.52

As it can be understood from the findings given in Table 2, according to the opinions of university students, the total mean score of the educators' justice in classroom management is 3.79, which indicates a partially high level as it ranges between 3.40 and 4.20. Considering the sub-dimensions of justice in classroom management, one may notice that the mean scores of the dimensions including interactional justice, procedural justice, reward allocation, and distributive justice range between 3.40 and 4.20, indicating that the perception of the sub-dimensions regarding justice in classroom management is also partially high. Although the values are not very different from each other, the highest score was given to the procedural justice dimension while the lowest score was given to the interactional justice dimension. This finding did not confirm H1 hypothesis. Unlike the statement of the authors reporting that according to the opinions of the university students, the perceptions of educators' justice in classroom management are at a moderate level, the findings have shown that they are at a partially high level.

Considering the findings in Table 2 in terms of university students' school engagement, the students' mean score was 4.13 points for school engagement, which indicates that the score is "partially high". As regards the dimensions of university students' school engagement, the mean scores of behavioural and emotional engagement also range between 3.40 and 4.20. These values also show that students' behavioural and emotional engagement is partially high. The mean score of cognitive engagement, on the other hand, is 4.22, indicating that students are cognitively committed to school at a high level. Although the mean values are quite close to each other, university students gave the highest score to the cognitive engagement dimension and the lowest score to the emotional engagement dimension. This finding did not confirm H2 hypothesis overall. While the researchers stated that university students have a high level of school engagement, the findings show that it is at a partially high level in the general total. H2 hypothesis was confirmed only in the cognitive engagement dimension.

The data showing the correlation between educators' justice in classroom management and school engagement according to the perceptions of the university students are shown in Table 3.

Table 3

Correlation between the Perception of Educators' Justice in Classroom Management and School Engagement

Variables	1	2	3	4	5	6	7	8	9
1. Interactional Justice	1								
2. Procedural Justice	.64**	1							
3. Reward Allocation	.65**	.74**	1						
4. Distributive Justice	.69**	.89**	.74**	1					
5. Justice in Classroom Management	.89**	.86**	.85**	.85**	1				
6. Behavioural Engagement	.52**	.50**	.53**	.52**	.57**	1			
7. Emotional Engagement	.53**	.45**	.51**	.48**	.57**	.73**	1		
8. Cognitive Engagement	.57**	.63**	.65**	.67**	.68**	.75**	.71**	1	
9. School Engagement	.50**	.46**	.52**	.50**	.57**	.78**	.83**	.78**	1

** $p < .01$ Correlation is significant at the level of .01.

Correlation analysis is performed when the relationship between two variables is examined. In the correlation analysis, the relationship between the variables is explained with values between .00 and 1.00. The closer the obtained values are to .00, the weaker the relationship between the variables. The closer the values are to 1.00, the higher the correlation level of the variables with each other. Büyüköztürk (2006) states that if these values are below .30, there is a weak correlation between the variables, between .30-.70 there is a moderate correlation, and if they are above .70, there is a high level of correlation between the variables. The correlation matrix in Table 3 shows that there is a moderate and positive correlation between university students' perception of total justice in classroom management and their school engagement mean score (.57**). The analysis of the sub-dimensions reveals that all sub-dimensions of the perception of justice in classroom management have a moderate, positive, and significant correlation with the sub-dimensions of school engagement and school engagement. This finding shows that H3 hypothesis is correct and confirmed.

Regression analysis was conducted to understand whether the perceptions of university students towards justice in classroom management predict school engagement. Table 4 shows the results of the analysis.

Table 4

Regression Analysis That Indicates That the Perceptions of University Students towards Justice in Classroom Management Predict School Engagement

Variables	B	SE	β	t	p	R ²	Adjusted R ²	Adjusted R-squared
Fixed	2.327	.118		19.671	.0001			
Interactional Justice	.095	.046	.157	2.078	.039			
Procedural Justice	.277	.032	.462	8.728	.0001			
Reward Allocation	.138	.047	.236	2.973	.003			
Distributive Justice	.126	.045	.205	2.823	.005	.23	.21	.19
Fixed	2,340	,118		19,868	.0001			
Justice in Classroom Management	.399	.034	.572	11.697	.0001			

Dependent Variable: School Engagement $F(1,282) = 13.578$ *; $p < .01$

The regression analysis data in Table 4 show that the standardized coefficients in the sum of justice in classroom management indicate $\beta = .57$; $t = 11,697$; $p < .01$. These standard values show that university students' perceptions of academic staff's justice in classroom management positively and significantly predict students' school engagement ($p < .01$). Looking at the adjusted R² to understand how much of the students' school engagement is explained by the perceptions of academic staff's justice in classroom management, one may observe that this rate is approximately 19% (Adjusted R² = .19).

Discussion

This research was conducted to determine the relationship between university students' perceptions of academic staff's justice in classroom management and their school engagement. In the study, first of all, the perception levels of the university students towards classroom management and their school engagement levels were determined. In the analysis conducted via the arithmetic means of the responses of the university students to the quantitative scale, the students reported that the fairness of the academic staff in classroom management was generally high, which indicates somewhere between intermediate and high and the fourth level on a five-point Likert scale. The studies on the classroom management levels of the instructors in the literature reveal that the results are generally similar to each other, though some differences exist too. Özgenel and Bozkurt (2019) examined the classroom management levels of the students' teachers along with sub-dimensions in a study including high school students and concluded the students scored 3.37 for their teachers' interactional justice, 3.58 for procedural justice, 3.24 for reward allocation, and 3.30 for distributive justice. These values indicate that students find their teachers' procedural justice generally at a high level while finding the levels of other categories of justice at a moderate level. In the study conducted by Nural (2015), students evaluated their teachers' level of justice in classroom management and gave their teachers a score of 3.39 on a five-point Likert scale, which indicates a moderate level based on the evaluation criteria of this study. However, it is very close to the "generally high level" shown in this study. If the mean value was 3.40, it would generally be considered high. The result of the study by Nural (2015) is compatible with the first hypothesis of this study and very close to the result obtained in this study. Considering these studies in the literature, it was thought in this study that the perceptions of academic staff's justice in classroom management would be at a moderate level, and thus, Hypothesis 1 had been developed. However, as a result of the research, it was observed that the

perceptions of the university students about academic staff's justice in classroom management were generally at a high level. The partial difference that occurred in this study from the result of other studies in the literature may be associated with the education level. Studies by Özgenel and Bozkurt (2019) and Nural (2015) focused on the high school level while this study was based on the university level.

The level of school engagement of university students was also examined as a variable. According to the results, university students' school engagement was generally at a high level. This result overlaps or contradicts some results from the literature. In the study conducted by Koç (2021), the relationship between students' school engagement and school climate was examined and students' school engagement was measured with sub-dimensions, and the study discovered that emotional and cognitive engagement was generally high while behavioural engagement was high. In the study conducted by Pehlivan and Özgenel (2020), the correlation between school climate, school engagement, and academic achievement was examined and students' school engagement was generally found to be high. However, the relevant study differs from this study in that it focused on secondary education institutions. It is suggested that one reason for this difference in the results may stem from the difference in terms of education level. In the study conducted by Açılan and Özgenel (2021), the school engagement of secondary and high school students was compared. As a result of the study, while secondary school students' school engagement was high, high school students' school engagement was moderate. One may notice that different results have been observed in studies conducted in the literature. However, in this study, a hypothesis was developed considering that university students' school engagement would be at a high level. It is suggested that the level of school engagement will be high because university students choose the schools of their own will and the university, they graduated from, is a huge factor for them throughout their future life. However, the result obtained was somewhere between high and moderate.

The results confirmed the hypothesis specifying that "There is a relationship between educators' justice in classroom management and student engagement according to the perceptions of university students. This relationship is positive and moderate". The literature review indicates that there is a positive relationship between the understanding of the teacher in classroom management and school engagement. Kırbaç (2019) reported a moderate relationship in teachers' understanding of classroom management in terms of all three sub-dimensions of students' school engagement. While students' school engagement has a negative relationship with the understanding of authoritarian classroom management, a positive relationship is observed with the understanding of democratic classroom management. Özgenel and Bozkurt (2019), who examined the correlation between high school students' perceptions of justice in classroom management and their school engagement, reported a positive relationship between students' perceptions of teachers' fairness in classroom management and students' school engagement. Selvitopu and Şahin (2013) concluded that students' perceptions of teachers' fairness in classroom management were associated with students' school engagement. Both the results of other studies in the literature and the result of this study show that if students believe that their teachers are doing fair classroom management, their school engagement level also increases. Perceptions of justice are positively related to school engagement. A student who thinks that the teacher has a fair approach to managing the class is most likely to think that s/he will not face injustice in the teacher's practices in the classroom, in relationships with her/his peers, in the application of school rules to all students, and the evaluation of the academic success of the students. The more the student is valued, the more committed s/he will be to school.

One of the research subjects was based on the investigation into whether university students' perceptions of academic staff's classroom management predict their school engagement or not. The results highlighted that the perceptions of the university students towards academic

staff's justice in classroom management predicted the students' school engagement. In the analysis, classroom management predicted school engagement both in total scores and all four sub-dimensions. The literature reveals some similar results. Özgenel and Bozkurt (2019) reported that while interactional justice and procedural justice dimensions predicted school engagement, reward allocation, and distributive justice dimensions did not predict school engagement. When compared with the research conducted by Özgenel and Bozkurt (2019), it can be argued that the difference arises from the difference between the sample groups and the difference in the interpretation of the university students regarding the grade distribution and the awards given by the instructors. Besides, Kırbaç (2019) has investigated the way teachers' understanding of classroom management predicts students' school engagement and found that teachers' understanding of classroom management predicts students' school engagement. The results of this study are similar to the results of this study. Another study that shed light on whether justice in management predicts engagement was conducted by Selvitopu and Şahin (2013) in terms of organizational justice. It was concluded that all sub-dimensions of organizational justice (procedural, distributive, and interactional) predicted organizational commitment. Considering that the results of such studies in the literature are similar to the results of this research, the fair behaviour of the academic staff in classroom management affects school engagement.

Conclusions and Implications

At the beginning of this research conducted at a secondary education level, the students considered the classroom management justice of teachers to be moderate. According to the results of this research, university-level students generally evaluated the classroom management justice of the instructors at a high level. This result is considered important as it is thought that students will make more rational assessments as their age increases and their education level rises. However, it should not be forgotten that students do not evaluate teachers' classroom management justice at a very high level. One of the results of the research is that university students generally have a high level of school engagement. It is thought that university students will have a high level of commitment to their schools because they choose their schools and the university, they graduate from, will affect them throughout their next life. However, the result obtained was between high level and medium level. This is possibly because the students do not willingly choose their department or get disappointed after enrolment. This result is considered important. The reasons can be investigated with more detailed studies.

Another result of this study is that the teachers' management of the classroom with justice increases students' commitment to the school. There is a positive correlation between students' perceptions of justice and their school engagement. There will be an increase in school engagement of students who believe that no injustice will be done to the teacher in the relationship with the students, in the equal application of the school rules to all students, and in the evaluation of the academic success of the students. It is very important for students to be happy where they are and to be connected to their school for their success. In this study, it was also concluded that the teacher's fairness in classroom management predicts student's school engagement. Studies in the literature show that school engagement increases both the climate in the school and the school success of the students (Koç 2021; Pehlivan ve Özgenel, 2020). Therefore, increasing student's school engagement is very important both for the school and for the student. One of the ways to increase student's school engagement (and therefore its success) is to ensure that the teacher provides justice in classroom management.

This research is different from other studies in terms of evaluating university students' own school engagement and faculty members' classroom management justice. The fact that the universe, sample, and subject of the research have not been discussed in the literature so far makes the results of the research special. Another unique aspect of the research is the

evaluation of the classroom management justice of the lecturers and the school engagement of the university students by the students themselves. When we look at the result obtained, the fact that it differs from the evaluations of high school and secondary school students shows this situation.

Educational organizations need to attach more importance to student satisfaction and loyalty than ever before in the 21st century. It is also very important for students to self-evaluate the variables that correlate with organizational commitment, satisfaction, and commitment. These aspects that make the research different and special can be evaluated by international researchers and it can be examined whether the research results are a global/general approach by reconsidering the subject with different samples in different parts of the world.

Recommendations for Educators

Although teachers' justice in classroom management is at a moderate level in a vast majority of studies in the literature, it was found to be generally high in this study. However, it is recommended that this level be increased more with enhanced attention to such values. In this study, students' school engagement was generally high in terms of emotional and behavioural engagement and high in terms of cognitive engagement. It is recommended that studies be conducted to increase students' emotional and behavioural engagement. Since there is a positive relationship between the perceptions of justice in classroom management and school engagement, the increase in the perception of justice is likely to increase school engagement as well.

Recommendations for Researchers

New samples, different times, and contexts should be included in research on the relationship between university students' perceptions of academic staff's justice in classroom management and school engagement, the effects of these variables on each other, and their prediction of each other. Being in mind that the quantitative method was used in this study, different types of quantitative methods and qualitative methods can be used in different studies.

Ethics Committee Permission Information: Since data were collected from university students using quantitative scales for this study, ethics committee approval was required. An application was made to Şırnak University Ethics Committee for permission. Şırnak University Ethics Committee Presidency has informed us that the research is ethically appropriate with the letter dated 03.11.2021 and numbered 2021/104.

Note

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Declaration of Interest

Authors declare no competing interest.

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STRENGTHENING COLLABORATIVE RESEARCH PRACTICES IN ACADEMIA: FACTORS, CHALLENGES, AND STRATEGIES

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Abstract

This mixed-method research sought to identify the factors, challenges and strategies that enable and strengthen collaborative research practice in academia. Participants of the study are purposively chosen, self-selected faculty and students from an external campus and a unit in the main campus of a state university in Bulacan, Philippines, who have successfully completed collaborative research writing projects, presented collaborative research projects in conferences and symposia, or published said collaborative research projects. Data were gathered using a researcher developed instrument, validated, and checked for reliability. Analysis of results using principal components analysis led to the development of the DRREAM (Diversity, Role assignment, Relationship-building and peer interdependence, Ergonomic, flexible and adaptable processes, Acquisition of knowledge, skills and expertise, Motivation consideration) model, a conceptual framework on factors that strengthen effectual collaborative research writing; while the use of thematic analysis enabled the formulation of IPP (Individual, Professional and Personal) model, a conceptual framework on strategies to overcome challenges faced by collaborators in a collaboration research project. Finally, an Action Plan Framework for Effectual Collaborative Research Writing is proposed to promote the culture of collaborative research practices among the members of the academia.

Keywords: collaborative research writing, research collaboration factors, research collaboration challenges and strategies, research culture in academia

Introduction

Doing research work independently is a demonstration of intellectual grit, however, participating in collaborative research involves more intellectual virtues including curiosity, intellectual humility, attentiveness, intellectual carefulness, and open-mindedness, characteristics necessary to advance in the 21st century. Collaboration drives innovation and the creation and use of knowledge that enables an organization to be at-par with both its local and international counterparts (Duivenvoorde, et al., 2009). Working together and cooperating toward a common goal, the resolution of issues, problems, and crisis through collaborative research has never been more significant. It is only when people come together with their best ideas, harnessed skills, and talents and direct these toward a completion of a task, a project or overcoming a problem that has plagued institutions or societies at large that the best outcomes and products are produced. In fact, literature indicates that collaboration is one of the most crucial skills and competences that enable strong and successful organizations to continuously upgrade their performance (Simonin, 1997).

Even among professionals and learners, collaboration is shown to develop higher order thinking skills, boost one's confidence and self-esteem, enhance social and interpersonal skills

and hone leadership abilities (Gates, 2018). More significantly, the availability of plurality of perspective on a topic made available in a collaborative experience enables members to upgrade their learning experience (Repice, et. al., 2016). This is because the members of the group have their own expertise and personal insights that each member can learn from (Loveless, 2016). Participating in collaborative research promotes and improves a variety of competencies as humans develop and acquire skills by engaging in social activities according to Vygotsky's (1978) social-constructivism theory. Likewise, working together in teams or groups lessens the likelihood of procrastination because members wish to fulfill their tasks or role assignments at the time scheduled by the group (Ortiz-ortiz, 2017). Moreover, research on collaboration (Huerta & Bray, 2013; Kumar, 2017; Destriana, 2018) illustrated positive learning impact on the grade point average of learners and the use of collaborative learning strategies improved academic performance, enabling them to become efficient problem-solvers and further developing social skills.

In the Philippine context, studies on collaboration illustrate that learners who utilized collaborative activities such as peer mentoring, group problem-solving and group games better understand and acquire long term proficiency in concepts and skills (Gamit, et al., 2017). Likewise, in the study conducted by Gurat and Sagun (2017) collaborative learning technique improved the learners' problem-solving skills. Similarly, Laguador (2014) has claimed that using collaboration as a strategy in the delivery of teaching and learning in an outcomes-based environment encourages active participation among learners and cultivate leadership skills encouraging learners who may become future leaders devoted and committed to serve other people. However, review of literature illustrated that there is limited data on collaboration practices specifically geared towards research collaboration. Qitoras and Abuso (2021) have highlighted how valuable collaboration practices are in upgrading research capacity of higher educational institutions and their faculty. As Sprunger (2017) has underscored, when experts in diverse fields collaborate through research, the intersection of divergent fields leads to innovative and original ideas, products, technologies, and knowledge.

Several factors, challenges and strategies have been identified to influence collaboration practices in various fields. Mattessich, et. al (2001) have identified context, characteristics of members, process and structure, communication, purpose, and resources as significant factors contributing to successful collaboration. Chien et, al (2012) have identified similar factors, citing communication effectiveness, teamwork, safety culture, job satisfaction, work climate, and work pressure as factors influencing collaboration within a tertiary medical center. Patel, et. al. (2012) have recognized the significance of collaborative working environments, identified seven main categories of factors involved in collaboration including context, support, task, interaction process, teams, individuals, and overarching factors.

Likewise, Kolfshoten, et. al. (2008) identified challenges and issues faced by collaborators engaged in collaboration including identifying the specific roles of members of the group, the group composition, the process of interaction among members, modelling rules, approaches, and quality. Similarly, Kwibisa and Majzoub (2018) noted common issues in collaboration activities namely: the lack of clear objectives and goals, lack of drive among collaborators, unclear division of responsibilities, lack of transparency, unclear shared benefit, absence of collective identity and conflict of interest. To address these challenges and issues, various strategies have been identified in literature including addressing mutual expectations, clear delineation of tasks, determination of authorship, frequent communication, recording of meetings, data access and expectations about data output, and shared responsibility for the integrity of the research project (University of Nebraska-Lincoln, 2022). In addition, Apostolakis (2003) has enumerated strategies involving member selection, shared vision, collaboration structure, planning and review of processes to address the issues and challenges of collaboration raised earlier.

The study looks into whether the issues identified in literature are experienced by participants in their research collaboration practices in the academia and how academics address these. This is the impetus for this study as it probes the factors, challenges and strategies utilized by members of Bulacan State University who have successfully completed research projects through collaboration. This study shall organize and foster productivity and creativity in research writing by looking into domains that enable the effectual implementation of collaborative research writing. This study has a possible impact in Bulacan State University's advocacy of delivering quality Education and the Pedagogy for the Filipino Learners.

The study aimed to develop a framework for strengthening effectual collaborative research practices in the academia which shall be used as basis in designing a program on how to effectively implement collaborative research projects. More specifically, this study sought to answer the following research questions:

1. What are the factors that enable the effectual conduct of collaborative research among members of Bulacan State University-Sarmiento Campus and College of Education (Main) who have successfully completed collaborative research?
2. What are the difficulties/ challenges encountered in collaborative research writing?
3. What are strategies for overcoming the difficulties/ challenges in collaborative research writing?
4. How can the results of the research be used as in designing a program/plan of action on how to effectively implement collaborative research writing?

Research Methodology

General Background

The present study employed mixed-method research design, with the first research question gathered and analyzed using quantitative techniques while research questions 2, 3, and 4 utilized qualitative methods. This study planned to collect data from the Likert scale survey questionnaire distributed to faculty members and students of BulSU-Sarmiento Campus and the BulSU-College of Education (CoEd), a state university in the Philippines, using Microsoft Forms. The study sample is limited to faculty members and students of BulSU-Sarmiento Campus and the BulSU-College of Education (CoEd) with experience in participating in research collaboration.

Sample

Study employed convenient sampling technique and collected data from faculty members and students of BulSU-Sarmiento Campus and the BulSU-College of Education (CoEd) with any one of the following experiences: (1) have successfully collaborated with colleagues in presenting a research paper at a national or international conference, (2) have successfully collaborated with colleagues in publishing a research paper in Scopus-indexed journals or other credible publications, and (3) have successfully collaborated with colleagues in the conduct, writing, and completion of a research. The study sought permission from the campus Dean of Sarmiento and the Dean of CoEd and then from the participants. Institutional ethical clearance was also sought from the university research management office to conduct the present study. The researcher assured the confidentiality of data collected, and that the data are accessible only to the researcher. The sample size is limited as responses from participants who did not have experience in collaboration research were not included in the analysis. The demographic profile of participants is shown in Table 1.

Table 1
Summary of Participants' Demographic Profile

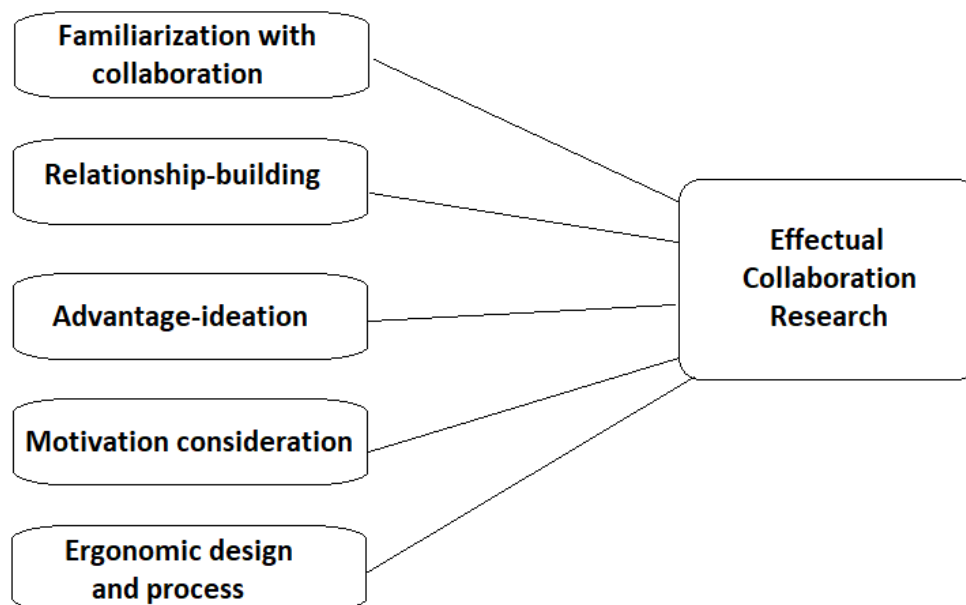
Sex	n	%
Male	(12)	35.29
Female	(22)	64.71
Total	(34)	100
University Unit Affiliation		
Sarmiento Campus	(14)	42.3
College of Education	(20)	57.7
Total	(34)	100
Educational Qualification		
Undergraduate	(17)	50
Bachelor's Degree	(8)	23.52
Master's Units	(2)	5.88
Master's Degree	(7)	20.59
Doctorate Degree	(0)	0
Total	(34)	100
Experience in Research Collaboration		
I have successfully collaborated with colleagues in presenting a research paper at a national or international conference.	Yes (13)	38.24
	No (21)	61.76
I have successfully collaborated with colleagues in publishing a research paper in Scopus-indexed journals.	Yes (7)	20.59
	No (27)	79.41
I have successfully collaborated with colleagues in the conduct, writing, and completion of a research project.	Yes (34)	100
	No (0)	0

Instrument Used

The present study used researcher-made questionnaire on factors, challenges, and strategies for effectual collaborative research based on the literature. The questionnaire had consent forms and personal demographic details in the first section and the second section had items on factors, challenges, and strategies for effectual collaborative research. Figure 1 is forwarded containing integrated factors that may influence collaboration research practices in the academe.

Figure 1

FRAME Model: Proposed Conceptual Framework on Factors that Strengthen Effectual Collaboration Research in Academia



The conceptual framework proposes five factors that may strengthen effectual collaboration research practices in the academia which include familiarization with collaboration, relationship-building, advantage-ideation, motivation consideration and ergonomic design process. Familiarization with collaboration deals with a collaborator's understanding of what it means to be part of a collaboration, his role, contribution to the completion of the task, expertise offered, individual differences that influence team dynamics, experiences in collaboration and individual values. The second factor is relationship-building which refers to support from management and colleagues, peer interdependence, respectful interaction among collaborators, and development of professional linkages. Third is advantage-ideation referring to mostly individual development and growth experienced by a collaborator in terms of enhancement of independent learning, metacognitive awareness, communication skills, upgraded content knowledge and broadened perspective, improved expertise and rigor in research methodology and critical thinking skills. The fourth factor deals with the collaborator's intrinsic desire to participate in collaboration research, external factors such as funding, incentives, and utility of research outputs, outcomes, and products for the institution, identified as motivation consideration. Finally, ergonomic design and process factor involves goal setting, efficiency in preparation and implementation of research tasks, providing and gathering feedback through purposeful interactions, safe and non-competitive work environment and flexibility and adaptability of team-members. The opinion of participants on the five identified components shall be collected and evaluated to identify how much of a factor these are in strengthening effectual collaborative research in the academia.

The identified factors and challenges based on literature were utilized as basis for development of a 6-point Likert scale research questionnaire, which was validated by three experts, and was tested for reliability with a Cronbach α of .860 (High Reliability) for

Familiarization component, .763 (High Reliability) for Relationship-building, .930 (High Reliability) for Advantage-ideation, .779 (High Reliability) for Motivation, and .954 (High Reliability) for Ergonomic design (Nunnally, 1979).

Data Collection Procedure

Research sought the permission of the head of the units identified to collect the required data. The questionnaires were sent to the program heads of the BulSU-Sarmiento Campus and CoEd. The researcher assured the anonymity of the data collected to the participants. The questionnaire was available from the 2nd week of April until April 30, 2022. Out of the total forty-five responses, the researcher included thirty-four completely filled-out responses from participants that have experience participating in collaborative research. Afterwards, researcher cleaned the quantitative data and then fed into SPSS version 22 to conduct the quantitative analysis, while the qualitative data was utilized using thematic analysis.

Data Analysis

The study used mean, standard deviation, and principal component analysis (PCA) to identify the significant factors that strengthen collaborative research as perceived by participants in the present study. The qualitative data was analyzed using thematic analysis. The thematic analysis provided a significant amount of flexibility that enabled researchers to look deeper into the participants' individual experiences. The thematic analysis method is composed of six steps: (1) familiarization with the data, (2) coding, (3) generating themes, (4) reviewing the themes, (5) defining and naming themes, and (6) interpretation and reporting (Braun & Clarke, 2013).

Research Results

The researcher conducted summary statistics test to find out the mean perception of participants on the factors that influence their collaborative research practices based on their experience. Table 2 shows the results of the scale statistics test.

Table 2
Factors Enabling the Effectual Conduct of Collaborative Research Writing

Factors	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
Familiarization with collaboration	34	5.35	0.59	To a moderate point
Relationship-building	34	5.34	0.66	To a moderate point
Advantage-ideation	34	5.34	0.69	To a moderate point
Motivation consideration	34	4.35	1.05	To some extent
Ergonomic Design and Process	34	5.33	0.73	To a moderate point
6-To a great extent	3-Very little			
5-To a moderate point	2-Unsure			
4-To some extent	1-Not at all			

The results illustrated in Table 2 show that among the five factors that influence successful collaborative research practices of BulSU Sarmiento Campus and College of Education faculty and students, being familiar with collaboration was the most significant factor with $\bar{x} = 5.353$, *to a moderate point*.

Table 2.1*Level of Familiarization with Collaboration*

Components	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
I understand what collaboration means.	34	5.50	0.75	To a great extent
I understand my role as a part of a collaborating group.	34	5.50	0.75	To a great extent
I expect all the members of my team to contribute equally to the group task.	34	5.24	0.92	To a moderate point
I understand that each member's task must be aligned with his/her expertise for optimal performance.	34	5.35	0.85	To a moderate point
I understand that individual personalities and differences may influence team dynamics.	34	5.38	0.82	To a moderate point
I understand that prior experience influences the performance of team members in task assignments.	34	5.47	0.66	To a moderate point
I understand that differences in advocacies may influence the team's interpretation of data collected.	34	5.02	0.83	To a moderate point
Mean		5.35	0.59	To a moderate point
6-To a great extent	3-Very little			
5-To a moderate point	2- Unsure			
4-To some extent	1-Not at all			

Table 2.1 illustrates the different components of Factor 1: Familiarization with Collaboration which showed that participants understand to a great extent what it meant to take part in a collaboration, $\bar{x} = 5.5$, and they understood to a great extent their role as a part of a collaborative research group, $\bar{x} = 5.5$.

Table 2.2*Level of Relationship-Building*

Components	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
Involvement or support from Top management and colleagues enable me to successfully complete collaborative tasks.	34	5.15	1.07	To a moderate point
Peer interdependence is evident in the way the members of my team trust and rely on each other.	34	5.29	0.87	To a moderate point
Respectful interaction is evident when our team members discuss issues, problems, or difficulties with the project.	34	5.51	0.71	To a great extent
My collaborative experiences enable the development and creation of new professional connections and relationships.	34	5.41	0.78	To a moderate point
Mean		5.346	0.66	To a moderate point
6-To a great extent	3-Very little			
5-To a moderate point	2- Unsure			
4-To some extent	1-Not at all			

Relationship-building scored a $\bar{x} = 5.346$, *to a moderate point*, however, one of most significant components in Factor 2: Relationship-building was the respectful interaction among members of the collaborative research group with a $\bar{x} = 5.51$, *to a great extent*. Expanding networks and professional connections and relationship was also highly regarded with a $\bar{x} = 5.41$, *to a moderate point* as shown in Table 2.2.

Table 2.3
Level of Advantage-Ideation

Components	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
Engagement in collaborative tasks promotes my independent learning as I need to prepare well to be able to actively participate in brainstorming and discussions.	34	5.41	0.78	To a moderate point
My metacognitive awareness is enhanced.	34	5.32	0.77	To a moderate point
My communicative skills are enhanced as collaboration involves interaction with my team members.	34	5.41	0.86	To a moderate point
My content knowledge is upgraded as the experts in my team contribute to the team discussion.	34	5.41	0.74	To a moderate point
My perspective is broadened as plurality of perspective creates a rich and robust pool of knowledge.	34	5.38	0.82	To a moderate point
My acquired knowledge and information have more rigor as variety of expertise and perspective guides methodology and interpretation.	34	5.26	0.83	To a moderate point
Problem-solving has become more efficient as more people may present viable solutions when problematizing research issues and trends.	34	5.24	0.99	To a moderate point
Mean		5.349	0.69	To a moderate point
6-To a great extent				3-Very little
5-To a moderate point				2- Unsure
4-To some extent				1-Not at all

The second most significant factor on effectual collaborative research practices was Factor 3: Advantage-ideation with a $\bar{x} = 5.349$, *to a moderate point*. Table 2.3 illustrates those three elements of Factor 3: Advantage-ideation showed that participants believed that participating in collaborative research promoted their independent learning, enhanced their communication skills, and upgraded their content knowledge with a $\bar{x} = 5.41$, *to a moderate point*.

Table 2.4
Level of Motivation Consideration

Components	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
I have an intrinsic desire to participate in collaboration.	34	5.03	0.90	To a moderate point
External factors contribute to why I participate in collaboration tasks.	34	4.94	1.15	To a moderate point
I receive funding for collaborative research projects.	34	3.55	1.78	To some extent
I receive incentives offered by the university for participating and completing collaborative projects.	34	3.74	1.81	To some extent
Collaborative projects I participate in are utilized for accreditation and audit requirements of the institution.	34	4.53	1.38	To a moderate point
Mean		4.359	1.05	To a moderate point
6-To a great extent				3-Very little
5-To a moderate point				2- Unsure
4-To some extent				1-Not at all

On the other hand, internal and external motivation scored the lowest mean evaluation among the factors that enabled effectual collaborative research practices of BulSU Sarmiento Campus and College of Education faculty and students, with $\bar{x} = 4.359$. *to some extent*. Table 2.4 illustrates the different components of Factor 4: Motivation consideration which showed that participants received *to some extent* funding for participating in collaborative research projects with $\bar{x} = 3.55$, and they also received *to some extent* ($\bar{x} = 3.73$) incentives offered by the university. Internal motivation, however, was the most significant motivation consideration of participants as it influenced their collaboration practices *to a moderate point* ($\bar{x} = 5.03$).

Table 2.5
Level of Ergonomic Design and Processes

Components	<i>n</i>	$\bar{x}$	<i>SD</i>	Interpretation
Collaboration enables me to identify more clearly the goal of a research project and achieve the intended outcomes.	34	5.32	0.77	To a moderate point
Preparation and implementation are more effective and efficient with collaboration.	34	5.47	0.75	To a moderate point
Peer feedback and interactions provide for a more purposeful research design.	34	5.35	0.81	To a moderate point
Collaboration has fostered non-competitive and a safer work environment.	34	5.24	0.85	To a moderate point
Collaboration enhances flexible work experience as adaptability of team members are improved.	34	5.29	0.80	To a moderate point
Mean		5.33	0.73	To a moderate point
6-To a great extent	3-Very little			
5-To a moderate point	2- Unsure			
4-To some extent	1-Not at all			

Finally, Ergonomic design and process ranked as fourth in the level of influence that enabled effectual collaborative research practices of the participants with a $\bar{x} = 5.335$, *to a moderate point*. Of all the components, Table 2.5 shows participants believed that the preparation and implementation of research were more efficient and effective with collaboration with a $\bar{x} = 5.47$, *to a moderate point*. Moreover, peer feedback and interaction among members of the collaborative research project were also identified as factors that enabled effectual collaborative research practices with $\bar{x} = 5.33$, *to a moderate point*.

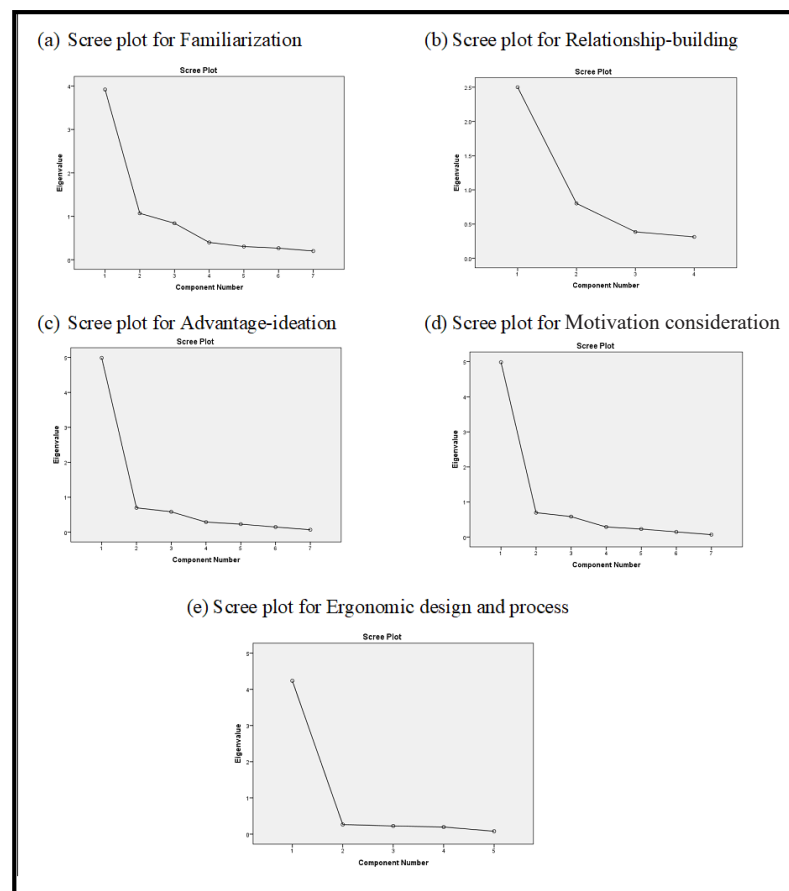
However, using principal component analysis (PCA), the factor loading result of the components of each factor illustrated changes in the FRAME Model. Table 3 shows the results of PCA illustrating two components extracted from Factor 1-Familiarization with collaboration, while the individual components of the four other factors loaded or related to only one principal component.

Table 3
Results of Principal Component Analysis - Component Matrix

	Components		Relationship-building	Component	Advantage-ideation	Component	Motivation Consideration	Component	Ergonomic design & process	Component
	1	2								
Item7	.877				Item 12	.751	Item 19	.751	Item 26	.923
Item6	.839		Item 8	.561	Item 13	.748	Item 20	.748	Item 27	.899
Item5	.778		Item 9	.876	Item 14	.862	Item 21	.862	Item 28	.924
Item1		.840	Item 10	.855	Item 15	.924	Item 22	.924	Item 29	.910
Item2		.743	Item 11	.829	Item 16	.896	Item 23	.896	Item 30	.946
Item3		.643			Item 17	.836	Item 24	.836		
Item4	.560	.585			Item 18	.875	Item 25	.875		

The components extracted from each factor is illustrated in the scree plot illustrated in Figure 2.

Figure 2
Scree Plot Results of Factors for Effectual Collaboration Research



Further, Table 4 illustrating the results of KMO, and Bartlett's Test showed that all six factors, as a set, significantly correlates at p -value .0001 ($\alpha \leq 0.05$), thus, the model shows interconnection among the factors.

Table 4
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.848
Bartlett's Test of Sphericity	Approx. Chi-Square	121.862
	<i>df</i>	10
	<i>p</i>	.0001

Challenges encountered in collaborative research writing

There are challenges in conducting collaborative research projects. Table 5 illustrates twelve challenges faced by participants in conducting collaborative research projects ranked according to the number of participants who encountered the said problem.

Table 5
Challenges of Collaborative Research Writing

Challenges	<i>f</i>	%	Rank
Accepting that you are not the only expert in the group	19	55.88	1
Conflicting priorities, misunderstandings	16	47.06	2
Unclear or uncomfortable roles or task assignments	15	44.12	3
Accepting that you do not have expertise in specific areas or subject matter	14	41.18	4
Shift from "I tell, you do" to "We talk, we work together."	11	32.35	5
Oversharing information	8	23.53	6
Conflict in taking responsibility for problems or credit for success	7	20.59	7.5
Time management and scheduling	7	20.59	7.5
Unequal opportunity due to employment status	6	17.65	9
Friction of ideas	5	14.71	10
Lack of access to credible sources	4	11.64	11
Barriers in communication	2	5.88	12

The results showed that the primary problem faced by 55.88 percent of the participants was *accepting that they are not the only expert in the group*. This may mean that ideas relevant to the topic, or decisions about the research are reached through consensus and participants may find it hard to reach a consensus because expert members may have differing opinions. This possibly leads to *misunderstanding and conflicting priorities* which is the second most experienced challenge in the conduct of collaborative research project with 47.06 percent of the participants claim to have experienced. Third, 44.12 percent of participants also experience unclear role assignments or feel uncomfortable in the tasks assigned to them. The fourth most experienced challenge in collaborative research writing is *accepting the one is not an expert in a specific area* with 41.18 percent of the informants. This may mean that participants may

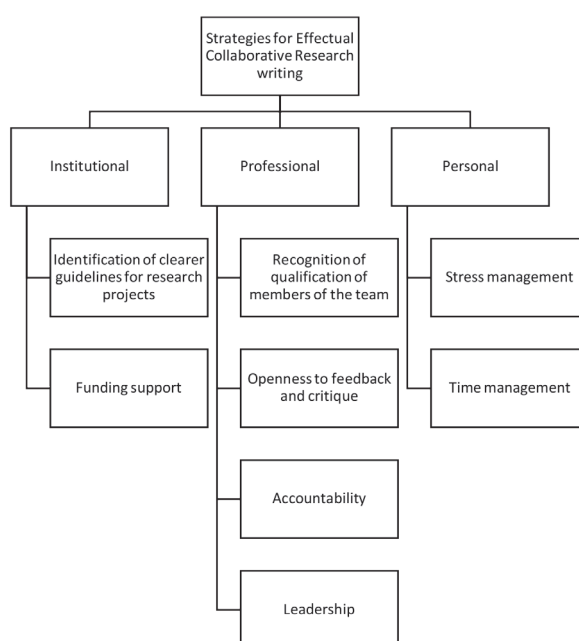
feel uncomfortable not being as knowledgeable as other members in certain aspects of the research work. Despite the limited physical interaction in the last two years because of the pandemic, *barriers in communication* were the least identified challenges in the conduct of effectual collaborative research writing with only 5.88 percent of the participants claiming to have experienced it. This may be because access to digital technology and the internet may have been useful to bridge communication barriers despite the physical distance. Moreover, the second least experience challenge is lack of access to credible sources with only 11.64 percent of participants claiming to experience it, despite lack of access to physical libraries and books. This again may be explained by availability of digital tools and internet access of participants which enable them to access digital libraries and resources.

Strategies for overcoming the challenges of collaborative research

The participants identified strategies to overcoming the difficulties/ challenges they faced in collaborative research writing. The responses were analyzed using thematic analysis and were coded and classified into three major themes – Institution, Professional and Personal (IPP) strategies for effectual collaborative research writing. As shown in Figure 3, under institutional strategies, the (1) identification of clear set of guidelines in the conduct of the research project and (2) provision of funds to support the conduct of the research projects are strategies that are identified to enable the effectual conduct of collaboration in research. Under professional strategies, there are four strategies enumerated: (1) that members duly recognize each member's qualification to take part in the collaboration, (2) that members are open to feedback and critique, (3) that members are accountable to the roles and tasks assigned to them, and (4) that each member is ready to step up and take leadership role when necessary. Finally, in personal strategies include (1) making the research writing process less stressful and (2) managing the time well.

Figure 3

IPP Model: Strategies for Overcoming the Difficulties / Challenges in Collaborative Research Writing



Based on the results, the Action Plan Framework for Effectual Collaborative Research Writing is forwarded (see appendix a). In this framework, the DRREAM factors identified in the study, the challenges, and the IPP strategies must be recognized, addressed, applied, and included as part of a training program to encourage collaboration in research projects so that the goal of Bulacan State University to produce Innovative, Advanced, and Relevant Research projects may be accomplished.

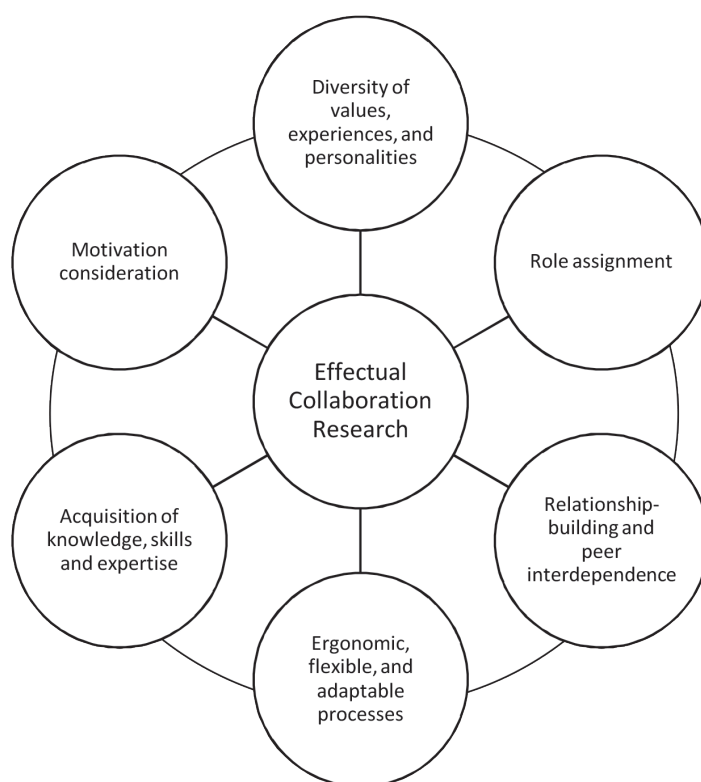
Discussion

As the value of research collaboration is highlighted in higher education institutions, the demand to capacitate and upgrade collaboration research skills among members of the academia is also more significant than ever. The results showed that there are six factors that contribute to strengthening the effectual collaborative research practices of members of the academia who participated in the present study and these support works by Mattessich, et. al (2001), Chien et, al (2012), and Patel, et. al. (2012) who have identified factors contributing to successful collaboration practices in varied fields. This implies that collaboration practices are influenced by similar factors across disciplines and that capacitating members of the academia to manage the factors identified may enable them to participate more in collaborative activities, more so collaborative research.

Given the results of the analysis, the following changes in the proposed FRAME Model, the conceptual framework on factors that strengthen effectual collaboration research in academia shall be made, as shown in Figure 4.

Figure 4

DRREAM Model: Revised Framework on Factors Strengthening Collaborative Research



The revised model illustrates six factors that strengthen effectual collaboration in the academia as compared to the original five factors. The first factor, familiarization with collaboration, upon analysis extracted two principal components. Items 5, 6 and 7 factor loads with component 1, with item 7 having the highest factor loading at .877. This new factor is renamed diversity of values, experiences, and personalities of collaborators. Items 1, 2, 3, and 4 loads with component 2, with item 1 having the highest factor loading (.840), thus identifying the second component and new factor as role assignment. The originally second factor, relationship building, only had one principal component, but since item 2 of the components (peer interdependence) had the highest factor loading (.876), the factor is renamed relationship-building and peer interdependence. In terms of ergonomic design and process, the last item for factor 5 had the highest factor loading (.946) emphasizing flexibility and adaptability of processes, as such the factor is renamed ergonomic, flexible, and adaptable processes. Advantage-ideation is also renamed acquisition of knowledge, skills, and expertise to best illustrate item 4 which has the highest factor loading (.924) for what initially was factor 3. Finally, motivation consideration is retained which illustrates both intrinsic and extrinsic motivation to participate in collaboration research projects.

There are also challenges that collaborators face when doing research collaboration. The results affirmed previous studies on challenges in collaboration by Kolfshoten, et. al. (2008) and Kwibisal and Majzoub (2018), and ranked the challenges based on the opinion of participants on how frequently the challenges were experienced. The *acceptance that they are not the only expert in the group* proved to be the most common challenge faced by participants. This may imply that brainstorming ideas relevant to the topic, or decisions about the research are reached through consensus but participants may find it hard to reach a consensus because expert members may have differing opinions based on their expertise. This leads to *misunderstanding and conflicting priorities* which is the second most experienced challenge in the conduct of collaborative research like how the process of interaction among members of the collaborative group in a different discipline is also one of the most common problems according to Kolfshoten, et. al. (2008).

Despite these challenges though, strategies relating to the institution, professional and personal (IPP Strategies) domains contribute to overcoming challenges identified. Contrary to Apostolakis (2003) and University of Nebraska-Lincoln (2022), the strategies drawn from the results do not only focus on the dynamics of the members of the collaboration group but include the role of higher institutions, as well as professional and personal aspects that may enable a member of the academia to successfully take part in research collaboration.

The factors, challenges and strategies that emerged from the study affirm research on collaboration discussed in the literature review despite the varied context from the current study. This means that collaboration practices in various fields and areas of study share commonalities in factors, face similar dilemmas, and may adapt similar strategies for success.

Conclusions and Recommendations

In the context of the research, based on the results, the Sarmiento Campus and the College of Education may include in the faculty development seminars and student trainings topics that deal with Diversity of values, experience and expertise, Role assignments in collaboration, Relationship-building and peer interdependence, Ergonomic, flexible and adaptable processes, Acquisition of knowledge, skills and expertise, and Motivation consideration (DRREAM model) as these are factors identified to significantly influence effectual conduct of collaborative research projects. Likewise, a colloquium may also be organized where faculty and student researchers may share not just their research projects and results, but also the actual experiences, struggles and challenges in conducting research and listen to how these are overcome. Such

activity will surely inspire researchers old and new alike, as stories of the fall and the conquest, the highs, and lows, the good and the bad, serve as true narratives that can provide rich and meaningful content for reflection.

Finally, trainings and workshops on Institutional, Professional, and Personal (IPP) Strategies for Effectual Collaborative Research Writing may also be conducted which would include orientation on university research guidelines, timelines and dissemination of information on university funding support, training and workshop on professional strategies which include research project leadership, accountability, accepting feedback and critiquing, and communication skills development, and personal strategies – time management skills development as well as stress management skills.

For future researchers, the study may be replicated in all other external campuses and colleges in the university to further establish, affirm or negate the conceptual frameworks developed.

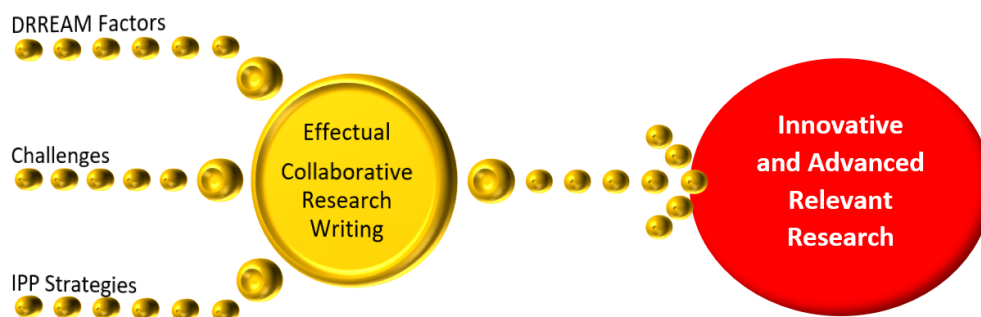
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Appendix A

Action Plan Framework for Effectual Collaborative Research Writing



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ASSOCIATION BETWEEN ATTITUDES TOWARDS SCIENCE SUBJECTS AND GRADES: THE MEDIATION ROLE OF LEARNING STRATEGIES

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Abstract

The students' attitudes towards school subjects may influence their behaviour and various educational outcomes. The research aimed to test students' attitudes towards the subjects of Biology, Chemistry, and Physics, and to examine the associations between those attitudes and students' learning strategies and grades achieved. The study included 245 eighth-grade students from five schools in Koprivnica-Križevci County in the Republic of Croatia. Attitude scale towards science subjects and Learning strategies scale were employed. The results of the analysis of variance showed a significantly higher assessment of interest for Biology and Physics than for Chemistry, while the assessment of importance for Biology was significantly higher than for Chemistry and Physics. Attitudes toward Biology, Chemistry, and Physics were positively correlated with the grades achieved in those subjects. Results of the mediation analysis indicated that the learning strategies were mediators between the attitude towards the science subject and the grades achieved in those subjects. Students with a more positive attitude towards a subject employ a deeper approach to learning, which ultimately results in a higher grade.

Keywords: lower secondary education; mediation analysis; school achievement, scientific subjects; student attitudes

Introduction

The importance and benefits of scientific learning, both in general and in the education system, have increased in step with the increasingly rapid development of science and technology. Since the natural sciences¹ are considered the foundation of virtually everything we use today and are surrounded by (International Council for Science - ICS, 2006), contemporary and future societies require a higher level of general competencies in these scientific fields. However, lifelong engagement in the natural sciences demands more than just knowledge and skills, and this largely depends on the attitudes students have towards them (Braš Roth et al., 2017). Since these attitudes are formed early (already between the ages of 10 and 14 years), it is important to encourage and maintain positive attitudes, as after that period, they are difficult to change (Osborne & Dillon, 2008; Savelsbergh et al., 2016). For that reason, natural science classes in primary and lower secondary school have a powerful and long-term effect on students.

¹ In Croatia, the natural sciences in the compulsory education system include the subjects Nature and Society, Nature, Biology, Chemistry, Physics and Mathematics. The subjects of this study are students in 8th grade classes and the subjects of Biology, Chemistry and Physics.

Students' Attitudes Towards Science Subjects

Research has confirmed that the negative attitude of students towards natural science subjects has not changed in decades (Adejimi et al., 2022; Durrani, 1998; Lyons, 2006; Mazana et al., 2019; Potvin & Hasni, 2014; Sjøberg & Schreiner, 2005). This is also the case in Croatia, as most students still show negative attitudes towards the science. Students assess these classes as too difficult, inefficient, boring, overly abstract, with too many concepts to learn and notes to take, and too little experience-based learning (Jokić, 2013; Marušić, 2006; Ward et al., 2005). A positive experience at the start of scientific education will lead to students achieving greater success, having a more positive attitude toward the sciences, and greater future interest in science overall (Akpınar et al., 2009). A positive attitude can also be encouraged by higher grades in these subjects, and support from teachers, parents, and colleagues (Ekici, 2010; Osborne et al., 2003; Samikwo, 2013).

Most students in lower secondary and secondary schools around the world show positive attitudes toward Biology (Hussaini et al., 2015; Martin et al., 2008; OECD, 2007), perceiving this subject to be interesting, important, relevant, and easier to understand (Prokop et al., 2007; Spall et al., 2003). Recent research in Croatia (Jokić, 2013; Marušić, 2006; Šimičić & Pešut, 2021) showed that students assessed Biology, unlike most other school subjects, to be very interesting, challenging, most understandable, and moderately hard, and for the most part, as useful and important for their future lives.

For Chemistry, students' attitudes are predominantly exceptionally negative. In the literature, the most common reasons for this are listed as the teaching methods, the content-heavy curriculum, presentation of isolated facts, and lack of relevancy. Students see Chemistry as a subject that is too difficult, too broad, too abstract, boring, and unimportant (Edomwonyi-Otu & Aava, 2011; Osborne & Collins, 2001). Research in Croatia (Jokić, 2013; Marušić, 2006; Šimičić & Pešut, 2021) revealed similar issues, and this is the reason that Chemistry is the least liked subject. Croatian students also assessed it to be uninteresting, hard to understand, abstract, difficult, useless, and unimportant for their future life. They believe that they must invest great efforts in learning Chemistry and that too much course content is taught.

For Physics, the situation is even more unfavourable, and many countries are investing great efforts to change the negative attitudes toward Physics (Drury & Allen, 2002; Institute of Physics, 2001). Students found Physics to be conceptually too difficult, requiring a great deal of work, to be unpleasant, scary, difficult to understand, unattractive, requires applied mathematical knowledge and a specific vocabulary, with overly broad curricula and programs, and the content is explained too quickly (Çalışkan et al., 2007; Spall et al., 2004; Stefan & Ciomoş, 2010). Research in Croatia (Jokić, 2013; Marušić, 2006; Marušić & Sliško, 2009; Šimičić & Pešut, 2021) found that Physics was one of the subjects that Croatian pupils were least interested in, and the reasons were the same as in other countries. However, Croatian students found it to be somewhat easier and more useful for the future than Chemistry (Jokić, 2013).

The attitude towards a subject is a significant predictor of academic success, meaning that a positive attitude activates the thoughts, feelings, and behaviour of the individual, motivating them to participate in learning processes, thereby improving their accomplishments (Albert et al., 2015; Wabuke, 2013).

There is also a possible inverse association, i.e., that accomplishments in a subject can lead to a more positive attitude towards that subject (Akpınar et al., 2009; Beaton et al., 1996). Owiti (2001) and Suzuki (2007) stated that this is a reciprocal influence, in which attitude affects accomplishments, and accomplishments affect attitude. Though the cause-effect relationship between attitudes towards a subject and success in that subject has not yet been fully researched, the results of previous studies have suggested that having a positive attitude

towards a subject could help to improve one's success in that subject. The question arises as to which mechanisms mediate the association between one's attitude towards the subject and success in that subject. This paper poses the hypothesis that learning strategies could be a possible underlying mechanism in that relationship.

Learning Strategies

Learning strategies are specific skills that students use to facilitate the acquisition, storing, or recollection of information (Oxford, 1990). Effective learning strategies facilitate the coding of information to increase its integration and accessibility (Weinstein, 1988). Learning strategies have been defined by different authors in different ways, though the deep and surface approaches to learning are most often referred to.

Students applying a *deep learning approach* are intrinsically motivated, seeking sense in the material they are learning, connecting new information with their existing knowledge and experience, and applying it. The purpose of learning is to satisfy their curiosity, out of enjoyment and personal interest (Aziz et al., 2012; Pintrich, 1999). Therefore, a deep learning approach is considered to be the most successful approach, as it leads to a conceptual understanding and retention of content. The results of students who learn in this way are better and longer-lasting (Marušić, 2013; Zhang, 2000).

Students applying a *surface learning approach* are extrinsically motivated, trying to avoid failure, not seeking any sense in what they are learning, and only superficially tackling the course content, reproducing, and remembering facts without making any connections (Gadelrab, 2011). They are motivated only to meet the requirements set by teachers and parents while investing the minimum effort (Duff et al., 2004). The surface approach results in a low quality of all learning outcomes (Coutinho & Neuman, 2008), which is particularly pronounced in learning scientific concepts (BouJaoude, 1992).

Most studies have shown a positive general association between academic success and the deep learning approach, and a negative association with the surface approach (Diseth & Kobbeltvedt, 2010; Hacıeminoglu, 2016; Vrkic & Vlahović-Štetić, 2013). In scientific subjects, a significant correlation has been found between self-regulated learning (which includes the deep processing of information) with learning quality and better students achievements in Biology (Ebele & Olofu, 2017; Partin & Haney, 2012; Sadi & Uyar, 2013; Uitto & Kärnä, 2014), Chemistry (Eidelman & Shwartz, 2016; Olakanmi & Gumbo, 2017; Sandi-Urena et al., 2012) and Physics (Cavallo et al., 2004; Hacıeminoglu et al., 2009; Vrdoljak & Vlahović-Štetić, 2018). Students who generally have a more positive attitude towards scientific subjects tend to prefer a deep learning approach, which in turn results in better academic success.

Although the positive association between students' attitudes towards scientific subjects and success in these subjects is well-established, the mechanisms underlying this association are not fully researched. Based on the aforementioned theoretical and empirical research, this study aimed to research whether learning strategies are the significant mechanism through which students' attitudes lead to better academic success in scientific subjects. In other words, do students who generally have a more positive attitude towards scientific subjects tend to prefer a deep learning approach, which in turn results in better academic success. The answer to this question contributes to understanding of the importance of students' attitudes toward scientific subjects and their consequences on the process and outcomes of learning.

Research Aim

This study aimed to test the differences in attitudes towards Biology, Chemistry and Physics among eighth-grade students and to examine the association between students' attitudes towards a subject and their grades in that subject. The mediation role of learning strategies in the association of attitude towards subject and grade in that subject was also examined.

The following hypotheses were tested:

- H1: The attitude toward Biology is statistically significantly more positive than the attitudes toward Physics and Chemistry.
- H2: The attitude towards the subject is positively correlated with the grade achieved in that subject.
- H3.1: The attitude towards the subject is positively correlated with the deep learning approach to that subject.
- H3.2: The attitude towards the subject is negatively correlated with the surface learning approach to that subject.
- H4.1: The deep learning approach to the subject is positively correlated with the grade achieved in the subject.
- H4.2: The surface learning approach to the subject is negatively correlated with the grade received in the subject.
- H5: The deep and surface learning approach to the subject are mediators between the attitude towards the subject and the grade achieved in that subject.

Research Methodology

General Background

This is an exploratory, quantitative, correlational-type study aimed to research students' attitudes toward natural science subjects and their association with learning strategies and grades. Attitudes toward Biology, Physics, and Chemistry were predictors, learning strategies (deep and surface learning) mediators, and grades obtained in these subject criteria variables. In this context, the study researched the effect of positive attitudes on promoting a deep learning approach, and consequently better grades in school. All variables were measured with self-report questionnaires. Data were collected in the middle of the second term in academic year 2017/18 during two weeks' period.

Sample Selection

A total of 245 eighth-grade students (139 females and 106 males) participated in the study. In Croatian educational system eighth grade is the last grade before enrolling in upper-secondary school. Students start with Biology in sixth grade and with Chemistry and Physics in seventh grade. In eighth grade they have formed attitudes toward natural science subjects and can report their grades in these subjects obtained at the end of previous year.

Five schools from urban areas of Koprivnica-Križevci County were included in the study. One county and urban areas were chosen in order to minimize differences in teaching quality and equipment of the schools needed for teaching natural science subjects. Schools and two intact classes from each school were randomly chosen. The total population of eighth-grade students in this county is around 1200, so the sample size is big enough to represent students from urban areas.

Instruments and Procedures

The Scale of student attitudes towards subjects in the natural sciences (Biology, Chemistry, and Physics) by Jugović (2010) was modified for the purpose of this study. The original scale consisted of 11 items for each subject. Students were asked to assess the interestingness, importance, and usefulness of each subject using a 5-point scale (from 1 – I completely disagree to 5 – I completely agree). An exploratory factor analysis using the principal components method with varimax rotation was conducted for each scale of each subject. All three factor analyses resulted in a two-factor structure, in which two items were excluded from further analysis due to their loading on both factors. The final scale resulted in two factors. The first consisted of five items about how interesting the subject is (e.g., *I find Biology very interesting*), and the second consisted of four items about the importance of the subject (i.e., *It is very important to me to get a good grade in Biology*). Cronbach α coefficients were .87 and .84 for interestingness and importance of Biology, .92 and .87 for interestingness and importance of Physics and .91 and .88 for interestingness and importance of Chemistry.

The Learning strategies scale is a subscale of the questionnaire *Components of self-regulated learning* (Niemivirta, 1999) translated and adapted by Rijavec et al., (1999). It has been widely used in Croatia with students attending lower secondary school (i.e., Rijavec & Brdar, 2002; Šimić Šašić & Sorić, 2011). The questionnaire consists of 10 items for each subject, in which the students express their agreement with each item using a 5-point scale (from 1 – I completely disagree to 5 – I completely agree). Five items are related to deep learning (e.g., *When I study Biology, I often go back to sections that I didn't understand or that were unclear*), and five to surface learning (e.g., *When I study Chemistry, I try to concentrate only on what the professor might ask*). Cronbach α coefficients were .79 (deep learning) and .68 (surface learning) for Biology, .86 (deep learning) and .78 (surface learning) for Physics and .86 (deep learning) and .78 (surface learning) for Chemistry.

Students received oral instructions and explanations of how to fill out the questionnaire. It was stressed that all questionnaires were anonymous, that there were no right or wrong answers, and that they could withdraw at any time during the study. Students had 30 minutes to fill out the questionnaires.

Data Analysis

Before analysis, the data were screened with respect to missing data, outliers, and violations of assumptions for the planned analysis. Values of skewness and kurtosis were in an acceptable range. Differences in the level of interestingness and importance of subjects were tested using repeated measures ANOVAs with different subjects as a within-subject factor. A linear regression analysis was used to assess the interestingness and importance of subject, as the predictor variable, and the grade achieved in this subject. Mediation analysis was performed using PROCESS macro for SPSS (Hayes, 2018).

Results of Research

Descriptive Results

The descriptive statistics and correlations of all variables are shown in Table 1.

The arithmetic means of the variables showed that the assessment of subject interestingness was around the average, while the assessment of subject importance was somewhat higher. The assessments of deep and surface approaches to learning were somewhat above average, but still somewhat lower for the surface approach. Grades were above average in all three subjects.

Table 1.
Descriptive Results and Correlations Among the Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B – i	-	.40	.19	.60	.31	.18	.51	.29	.27	.17	.10	.06	.36		
C – i				-	.65	.22	.29	.45	.22	.04	.19	.01		.46	
P – i					-	.60	.13	.08	.42	.03	-.05	.16			.14
B – I				-	.61	.41	.56	.44	.40	.25	.21	.13	.33		
C – I					-	.46	.49	.61	.40	.25	.35	.10		.48	
P – I						-	.24	.28	.50	.13	.09	.30			.28
B – DA							-	.61	.61	.59	.37	.35	.26		
C – DA								-	.56	.35	.65	.29		.34	
P – DA									-	.36	.35	.65			.22
B – SA										-	.56	.49	-.09		
C – SA											-	.49		.09	
P – SA												-			-.03
B – g	.36			.33			.26			-.09					
C – g		.46			.48			.34			.09				
P – g			.14			.28			.21			-.03			
M	3.37	3.05	3.35	4.05	3.79	3.81	3.68	3.70	3.77	3.49	3.52	3.57	3.83	3.70	3.83
SD	0.99	1.22	1.03	0.93	1.19	1.11	0.92	1.04	1.02	0.94	1.00	0.99	1.04	1.10	1.07
Range	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	2-5	2-5	2-5
Cronbach alpha	.87	.92	.91	.48	.88	.87	.78	.86	.86	.68	.78	.78	n.a	n.a	n.a

B – Biology; C – Chemistry; P – Physics

M – mean; SD – SD - standard deviation; n.a. – not applicable

i – interestingness; I – importance; DA – deep approach, SA – surface approach, g – grade

italics – $p < .05$; **bold** – $p < 0.01$

The correlations among the variables were in the expected direction. All correlations (except one) between the interestingness and importance of the subject and the deep learning approach were positive, as were the correlations with subject grades. However, the correlations between surface approach were not significant for subject interestingness, while contrary to expectations, they were positive for the assessment of subject importance. Also, the correlation between the deep learning approach was positive with grades, while the correlation between the surface approach and grades was not significant.

Differences in Attitudes Towards Biology, Chemistry, and Physics

To test the differences in the level of interestingness and importance of subjects, we used repeated measures ANOVAs with different subjects as a within-subject factor with three levels (Biology, Chemistry, Physics). For pairwise comparisons Bonferroni test was used.

For the interestingness of a subject, a significant effect ($F = 8.122$; $p < .001$) of the subject was found. As seen in Table 1, students assessed the interestingness of all three subjects to be somewhat above average. They equally and positively assessed Biology ($M = 3.37$; $SD = 0.99$) and Physics ($M = 3.35$; $SD = 1.03$) and there was no statistically significant difference ($p > .05$) between the assessments of these subjects, while the least positive attitude was found towards

Chemistry ($M = 3.05$; $SD = 1.22$), and this was significantly lower than the attitude towards Biology ($p < .001$) and towards Physics ($p < 0.05$).

In assessing the importance of subjects, there was also a significant effect of the subject ($F = 9.227$; $p < .001$). Students placed the highest importance on Biology ($M = 4.05$; $SD = 0.93$) and this was significantly higher than for Physics ($M = 3.81$; $SD = 1.11$; $p < .001$) and Chemistry ($M = 3.89$; $SD = 1.03$, $p < .001$), while there was no significant difference between the latter two ($p > .05$).

Generally speaking, it can be concluded that students found Biology and Physics more interesting than Chemistry, and Biology to be more important than the other two subjects. These results partly confirmed the first hypothesis.

Correlations Between Attitudes Towards Subjects and Grades in Those Subjects

A linear regression analysis was used to assess the interestingness and importance of Biology, as the predictor variable, and the grade achieved in Biology, as the criteria variable, and showed that both components of attitude were significant predictors of the grade. The beta coefficient for interestingness was 0.253 ($t = 3.417$; $p < .001$), and for importance was 0.174 ($t = 2.344$; $p < .05$). Both components together explained 15% of the variance of grades.

For Chemistry, the assessments of interestingness and importance were also significant predictors of the grade. The beta coefficient for interestingness was 0.269 ($t = 3.622$; $p < .001$) and for importance was 0.293 ($t = 3.955$; $p < .001$). Both components explained 26% of the variance of grades.

For Physics, only the assessment of importance proved to be a significant predictor of grades. The beta coefficient for importance was 0.306 ($t = 3.936$; $p < .001$). The assessment of the interestingness of Physics was not a significant predictor of grades. The beta coefficient was -0.046 ($t = 0.595$; $p > .05$). Both components explained 8% of the variance of grades.

These results confirmed the second hypothesis about the positive correlation between an attitude towards a subject and the grade achieved in that subject. The assessment of interestingness (except for Physics) and the importance of a subject were positive predictors of grades for all three subjects. These components of attitude best explained the grades in Chemistry and least in Physics.

Correlations Between Attitudes Towards Subjects and Learning Strategies for Those Subjects

Linear regression analysis was performed with the assessments of the interestingness and importance of Biology as a predictor variable, and a deep learning approach as the criteria variable. The analysis showed that both components of attitude were significant predictors of deep learning. The beta coefficient for interestingness was 0.283 ($t = 4.383$; $p < .001$), and for importance 0.380 ($t = 5.895$; $p < .001$). Both components explained 35% of the variance of the deep learning approach. With regard to the surface learning approach, interestingness was not a significant predictor for Biology, while importance was a positive and significant predictor for Physics. The beta coefficient for interestingness was -0.035 ($t = 0.454$; $p > .05$), and for importance 0.314 ($t = 4.052$; $p < .001$). Both components of attitude explained 6% of the variance of the surface learning approach.

For Chemistry, the importance of the subject was a significant positive predictor for the deep learning approach, while the interestingness of the subject was not a significant predictor. The beta coefficient for interestingness was 0.090 ($t = 1.338$; $p > .05$), and for importance was 0.550 ($t = 8.290$; $p < .001$). Both components explained 38% of the variance for the deep learning approach. For the surface learning approach, the interestingness of Chemistry was not a significant predictor, while its importance was. The beta coefficient for interestingness was

0.034 ($t = 0.437$; $p > .05$), while importance was 0.231 ($t = 2.979$; $p < .01$). Both components of attitude explained 9% of the variance of the surface approach to learning.

For Physics, both components of attitude were significant predictors of the deep learning approach. The beta coefficient for interestingness was 0.173 ($t = 2.512$; $p < 0.05$), and for importance was 0.404 ($t = 5.877$; $p < .001$). For the surface learning approach, the interestingness of Chemistry was not a significant predictor, while importance was a positive and significant predictor. The beta coefficient for interestingness was -0.035 ($t = 0.454$; $p > .05$), while for importance it was 0.314 ($t = 4.052$; $p < .001$). Both components explained 9% of the variance of grades.

These results only partly confirmed the third hypothesis, in which attitude is positively correlated with the deep learning approach and negatively with the surface learning approach. The interestingness of a subject proved to be a significant predictor of the deep learning approach in Biology and Physics, while contrary to expectations, the importance of a subject also proved to be a significant and positive predictor for surface learning for all three subjects.

Correlation Between Learning Strategy of a Subject and the Grade Achieved in That Subject

The linear regression analysis of the assessment of deep and surface learning approaches to Biology as a predictor variable, and the grade achieved in Biology as the criteria variable, showed that both learning strategies were significant predictors of the grade. Deep learning was a positive predictor of the grade, while surface learning was a negative predictor of the grade. The beta coefficient for deep learning was 0.475 ($t = 6.504$; $p < .001$), and for superficial learning was -0.373 ($t = 5.108$; $p < .001$). Both components together explained 16% of the variance of the grade.

For Chemistry, both the deep and surface learning approaches were significant predictors of the grade. As with Biology, deep learning was a positive and surface learning was a negative predictor of the grade. The beta coefficient for deep learning was 0.483 ($t = 6.160$; $p < .001$), and for surface learning was -0.217 ($t = 2.761$; $p < .01$). Both components together explained 14% of the variance of the grade.

The results for Physics showed the same pattern, with deep learning as a positive and surface learning as a negative predictor of the grade. The beta coefficient for deep learning was 0.416 ($t = 5.155$; $p < .001$), and for surface learning was -0.306 ($t = 3.792$; $p < .001$). Both components together explained 10% of the variance of grades.

This fully confirmed the hypothesis of a positive correlation between the deep learning approach to a subject and the grade achieved in that subject, and a negative correlation between the surface approach to learning and the grade achieved in that subject for all three subjects.

Mediation Analysis

Table 2 shows the results of the mediation analysis for Biology with attitudes as independent variables, grades as dependent variables and learning strategies as mediators.

Table 2

Mediation Role of Learning Strategies in the Relationship Between Attitudes Towards Biology and the Grade Achieved in Biology

Independent variable	Interestingness of Biology		Importance of Biology	
Dependent variable	Grade		Grade	
	β	SE	β	SE
Total effect (c)	0.363***	0.063	0.354***	0.071
Direct effect (c')	0.261***	0.071	0.248**	0.081
Indirect effect (ab)	0.102*	0.042	0.201*	0.057
Deep learning approach	0.157*	0.048	0.296*	0.079
Surface learning approach	-0.055*	0.028	-0.095*	0.032

In Table 3. the mediation analysis for Chemistry is presented with attitudes as independent variables, grades as dependent variables and learning strategies as mediators.

Table 3

Mediation Role of Learning Strategies in the Relationship Between Attitudes Towards Chemistry and the Grade Achieved in Chemistry

Independent variable	Interestingness of Chemistry		Importance of Chemistry	
Dependent variable	Grade		Grade	
	β	SE	β	SE
Total effect (c)	0.412***	0.051	0.472***	0.057
Direct effect (c')	0.331***	0.074	0.410***	0.071
Indirect effect (ab)	0.078*	0.029	0.062	0.046
Deep learning approach	0.108*	0.039	0.121*	0.058
Surface learning approach	-0.029*	0.018	-0.058*	0.029

The mediation analysis for Physics is presented in Table 3.

Table 4

Mediation Role of Learning Strategies in the Relationship Between Attitudes Towards Physics and the Grade Achieved in Physics

Independent variable	Interestingness of Physics		Importance of Physics	
Dependent variable	Grade		Grade	
	β	SE	β	SE
Total effect (c)	0.149**	0.056	0.280***	0.062
Direct effect (c')	0.047	0.061	0.221***	0.071
Indirect effect (ab)	0.102*	0.031	0.059*	0.041
Deep learning approach	0.147*	0.040	0.148*	0.052
Surface learning approach	-0.045*	0.024	-0.088*	0.037

The tables above show that the results for all three subjects indicate the same pattern. For each subject, there is a significant total indirect effect of learning strategy as a mediation

variable in the relationship between the assessment of interestingness and importance of a subject and the grade achieved in that subject. The total indirect effect was insignificant only for the assessment of the importance of Chemistry, though the individual mediators were significant. Generally, it can be concluded that there is a significant relationship between the assessment of interestingness and importance of a subject and the grade achieved in that subject and that this association is partly mediated by learning strategies. Students who found the subject more interesting and important were more inclined to use the deep learning approach, and less often the surface learning approach, which resulted in higher grades. In both cases, this was a partial mediation, indicating that there is a direct association between the interestingness and importance of a subject and the grade, or that there are other mediators that were not examined in this study.

These results confirm the fifth hypothesis on the mediation role of learning strategies in the association between the attitude towards a subject and the grade achieved in that subject.

Discussion

This study examined the differences in students' attitudes towards Biology, Chemistry, and Physics, and the relationship between the attitudes towards those subjects, learning strategies, and the grades achieved. It was assumed that students would have a more positive attitude toward Biology than towards Chemistry or Physics. It was also expected that students' attitudes towards particular subjects would be associated with their learning strategy (deep or surface approach), which would then lead to different educational outcomes. Specifically, it was presumed that students with more positive attitudes towards a given subject would be more inclined to apply the deep learning approach and less the surface learning approach, resulting in a higher grade in that subject.

Differences in Attitudes Towards Biology, Chemistry, and Physics

The results partially confirmed the first hypothesis (H1), that the attitudes toward Biology would be statistically significantly more positive than the attitudes toward Physics and Chemistry. Specifically, Biology was assessed as being significantly more important than Physics and Chemistry. Also, Biology and Physics were rated as equally interesting, significantly more than Chemistry.

Positive attitudes toward Biology correspond to the previous research in Croatia (Jokić, 2013; Marušić, 2006), and in the world (Hussaini et al., 2015; Martin et al., 2000, 2008; OECD, 2007) which also found that students positively assessed Biology. Several studies have shown that students find Biology more relevant to their daily life, and due to topics, such as the human body and overall health, they view Biology as capable of increasing the quality of life (Christidou, 2006; Dawson, 2000; Lamanaskas et al., 2004). Contrary to the expectations, students rated Biology and Physics as equally interesting. This result is surprising since research in Croatia over the past 15 years has found that Physics is one of the least liked subjects (Jokić, 2013; Marušić, 2006; Šimičić & Pešut, 2021), while in the world, students most often assess it to be difficult, hard to understand, and overly abstract (Institute of Physics, 2001; Spall et al., 2004; Stefan & Ciomoş, 2010). Therefore, in interpreting such results, one must certainly consider the personality, professional capabilities, and enthusiasm of Physics teachers, which can largely improve students' attitudes towards Physics (Barmby et al., 2008; Reid & Skryabina, 2003). It is important how well the classroom is equipped, and whether Physics class includes doing experiments, and students are guided using examples associated with daily life and taught the benefits that a career in Physics can bring (Brewer et al., 2009; Dilek Eren et al., 2015; Perkins et al., 2005; Reid & Skryabina, 2003). It is possible that this sample included schools with better

equipment for Physics teaching than the average, or with better-educated teachers, resulting in Physics being just as interesting to students as Biology. This, however, is an assumption that should be further examined.

In terms of importance, students consider that both Chemistry and Physics are less important for life than Biology. This is in line with previous studies (Angell et al., 2004; Hobson, 2003; Sert Çıbık & Yalçın, 2011) showing that students are less able to perceive the importance of Chemistry and Physics in daily life unless the teacher explicitly outlines this, and uses methods based on activities, simulation methods, and performs experiments that are necessary to understand the abstract teaching content in this subject. The reasons for not perceiving the importance of Chemistry and Physics are also due to a large number of facts, the difficulty for students to connect different concepts and processes that are presented to them and that they should be able to practically apply (Ćosić, 2015; Jokić, 2013; Osborne & Collins, 2001), as well as a lack of integrated animation that aids in the teaching of such concepts in Physics (Su & Yeh, 2014). Therefore, certain authors have recommended that the teaching of Chemistry and Physics should start with simpler concepts, with checks to determine whether students have truly mastered them, before moving on to more complex relationships and processes. ICT technology can play an important role in this process (Su & Yeh, 2014; Tuan Soh et al., 2010). Learning should start with the concrete and move towards the abstract, to avoid forming negative attitudes of students at their very first contact with these subjects, which in Croatia starts in the seventh grade.

Association Between Attitudes, Learning Strategies, and Subject Grades

According to the second hypothesis (H2), it was expected that the attitudes toward Biology, Chemistry, and Physics would be positively associated with the school grades in those subjects, which was generally confirmed. For both Biology and Chemistry, interestingness and importance were both significant predictors of grades, while for Physics the only significant predictor was the assessment of importance. Students with more positive attitudes toward Biology, Chemistry, and Physics show greater attention in class, participate more in scientific activities, and are better able to learn scientific concepts and skills in those areas, which lead to their better academic success in the form of grades (Baram-Tsabari & Yarden, 2007; Hidi & Harackiewicz, 2000; Jarvis & Pell, 2005; Yager, 1996). It remains unclear as to why only the importance of Physics was associated with grades, while its interestingness was not.

According to the third hypothesis (H3.1), it was expected that the students' attitudes toward all subjects would be positively correlated with a deep learning approach to these subjects, and negatively with a surface learning approach (H3.2). The results partly confirmed this hypothesis.

As expected, for all three subjects, the assessments of the interestingness and importance of the subject were associated with deep learning. However, contrary to expectations, the assessment of subject importance was also positively associated with surface learning, though to a lesser extent. It is obvious that students who find natural science subjects interesting and important will prefer to learn with understanding (deep learning) rather than just learn by memorizing (surface learning). This is in line with previous research, though very sparse, which also showed such associations in the field of Mathematics (Alkhateeb & Hammoudi, 2006; Zakariya et al., 2020). However, the question arises of why subject importance is associated also with a surface learning approach, as also seen in some other studies (Hacieminoglu, 2016). A possible explanation is that some teachers require reproduction of facts, and so the students take a surface approach to learning because the subject is important to them, and they want to obtain a better grade.

Research has confirmed the expectations that deep learning approach is positively (H4.1), and surface learning negatively associated with grades (H4.2). This is in line with research in Croatia (Putarek et al., 2016; Rijavec et al., 1999; Vrdoljak, 2016; Vrdoljak & Vlahović-Štetić, 2018), and elsewhere (BouJaoude, 1992; Cavallo et al., 2003; Hacıeminoglu et al., 2009; Hacıeminoglu, 2016). A surface approach to learning is based primarily on memorization. Students are focused only on what they expect the teacher will ask, they ask no additional questions, and do not highlight important sections but instead only repeat until they feel they have learned the content. This strategy finally results in lower grades.

As presumed, the results have shown that learning strategies are a mediator between the attitude towards subjects and the grades achieved in that subject (H5). For all three subjects, students who assessed the subject as both interesting and important were more inclined to take a deep learning approach, and less to take a surface learning approach, which ultimately resulted in higher grades in that course.

Limitations of the Study

This research is a correlation type study, therefore any conclusions about causality cannot be drawn from the findings. It is possible that attitudes towards natural science subjects influence the grades obtained in those subjects through the learning strategies, as presumed here. However, this association can also go the opposite way, for example, the learning strategy influences the grade, which then consequentially influences the attitude towards the subject. Therefore, future studies should include longitudinal research that would allow confirming possible cause and effect relationships between the variables tested in this study. Also, the research was conducted only in one county in Croatia, and therefore, we cannot generalize to the entire elementary school population. Since attitudes towards subjects change in relation to the situation in the school, particularly equipment in the classroom and education of teachers, research in other parts of Croatia would contribute to a better overall generalization of the obtained results.

Conclusions and Implications

Research involving natural science subjects in school has shown that students with positive attitudes towards these subjects also earn better grades. However, studies that try to investigate the mechanisms underlying this association are rare. In other words, we know that positive attitudes contribute to better grades but the reasons why this happens are still unclear. Results of this study point to learning strategies as a mediator between attitudes and grades. Students who have positive attitudes toward Biology, Physics and Chemistry more often use the strategy of deep learning while working to master the content in these subjects, which in turn leads to better grades. This finding, in addition to theoretical contribution, has practical implications suggesting educators and teachers to pay more attention to helping students develop positive attitudes towards natural science subjects as early as possible.

Future research should address other possible mediators between attitudes towards subjects and grades achieved in that subject. Coping with stress and test anxiety may be a promising line of research. Students with positive attitudes towards subjects experience positive emotions, which are known to improve cognitive functioning, which could help students to better cope with oral and written exams and achieve better grades.

Ethical approval

All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Declaration of Interest

The authors declare no competing interest.

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THE STATE, ACCESSIBILITY, AND SIGNIFICANCE OF EDUCATION IN SERBIA

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Abstract

International conventions state that the right to an education is a basic human right which countries are obliged to guarantee. In Serbia, as in most countries, this right is guaranteed by the Constitution. However, data on a large part of the structure of the Serbian population with a lower level of educational attainment indicated that one part of the citizens did not realize this right since they did not continue their education after primary school. Therefore, the aim was to determine how the citizens of Serbia evaluated the state of education in Serbia as a whole (its quality), the accessibility (whether there are fair opportunities in education for all categories of the population), and the significance of education in Serbia (whether the knowledge acquired, and skills developed are relevant for employment). The results were obtained by analyzing the latest data from the European Social Survey (ESS) from 2018/2019 in Serbia on a sample of 2043 interviewees. The study was carried out by trained interviewers, in face-to-face interviews. The initial hypotheses were confirmed: a) a low prevalence of high grades for the state of education as a whole, the accessibility, and significance of education in Serbia, and b) that there is a difference in the perception of education depending on some of the socio-demographic characteristics of the interviewees. The creation of a favorable social and institutional environment and changes in the education policy are preconditions for the improvement of the quality and accessibility of education in Serbia.

Keywords: education availability, education significance, education quality, social inequality, Serbia

Introduction

Social development, the personal interests and needs of individuals require a quality education which is, on the one hand, a precondition, and on the other, an expression of the level of cultural and socio-economic progress of each country. The beginning of the 21st century was marked by deep changes in the global society and the rapid development of the post-industrial society. The age of globalization is characterized by international connections, strengthening of the role of international institutions, the dominance of knowledge, and the rapid transfer of information from one corner of the world to another (Gidens, 2003). The significance of education in particular is increasing in contemporary society, when all forms of life are becoming more complex, when high technology is being introduced, and the need for constant changes, innovations and discoveries is being intensified. Education is ascribed an important role since contemporary systems could not function and exist without it, and one of the basic tasks of education is to get people used to change. The social significance of education can be viewed through its importance for social development, the development of the productive powers of society, of social and material reproduction, the social position of those acquiring an education, and the formation of their personalities. Education has a deciding role not only in the development of personality during one's entire life, but also in the development of all of society, which is necessary for a move towards a "society of education", and the creation of an educational society based on the acquisition, activation, and application of knowledge (Delor, 1996).

One of the more recent documents passed by the EU regarding the scope and conditions of education is the *European Pillar of Social Rights* which the European Commission ratified in 2017. The document contains twenty key principles, four of which refer to education, which confirms the significance of education for economic and social development. The first principle states that everyone has the right to a high quality and inclusive education and life-long learning to sustain and improve the skills and knowledge which could enable them to take part in the social community without hinderance, and to successfully adapt to the changes and requirements of the job market. The second principle states that women and men are equal in all rights and conditions for acquiring an education, and the third that each citizen has the right to an equal position in terms of education and accessibility to public goods and services (the emphasis is on marginalized groups in particular). Principle eleven states that children have the right to a quality education which is accessible to everyone, as well as the right to protection from poverty.

Investing in education as an important resource which is the instigator and basis for the development of society is part of the politics of all developed countries. Developed countries have noted the importance of knowledge and its application in terms of development and overcoming crises. People and their intellectual and creative potentials represent a strategic basis for the development of society, since they are the bearers of ideas, knowledge, and information (Račić, 2013, p. 96). The issue of the accessibility of education as a dimension of the quality of education is very current and complex, as it includes questions of social inequality and the mechanisms of social selection in education. Research into the perceptions of the state of education and the problems which arise in the form of the inaccessibility of education for members of various social groups, as well as the significance of education, is of considerable importance for a complete view of the quality of education, but also of social inequality in education. Social inequality is found in all areas of social life and affects various social groups, thus affecting the possibility of choice and the quality of education of an individual (for more details see Antonić, 2013; Cvejić, 2012; Marković Krstić & Milošević Radulović, 2015, 2020; Miladinović, 2011). The social structure affects the way of life of an individual, especially the process of their socialization and education, so it is very important to study the impact of social inequality on the educational potential of individuals (the accessibility of education) and the various forms of inequality in the field of education outlined in numerous theoretical approaches (Bourdieu & Passeron, 1977; Bowles & Gintis, 2002; Dirkem, 1981; Gamoran, 2001; Georgievski, 1997; Parsons, 1961).

Considering that contemporary society is a society of knowledge, the basic assumption for its development is knowledge and continued improvement, and its basic resource are individuals in possession of new knowledge and new skills. Therefore, it is necessary for education to be accessible to all citizens so that they could be equipped to take on various social roles, but also that the acquired knowledge and skills developed during education could be adequately valued on the job market and when seeking employment.

An imperative of the educational systems today is the democratization of education, that is, realizing rights to an education and the accessibility of education, as well as opening the way to its mass development on all levels. "Through the democratization of education, the principle of equal opportunities for all is promoted, a principle which incorporates the fundamental values of western culture (fairness, equality), and which is focused on bridging the gap between the rich and the poor" (Matejić Đuričić & Filipović, 2014, p. 88, authors' translation). The right to an education includes: 1) the right to *receive* an education, 2) the right to *choose* the type of education, and 3) the right to an *equal* education. The right to receive an education refers to the obligation of the state to provide and finance a system of education, the right to choose a type of education most often refers to the right to an education in a private school, in one's native tongue, or in adherence to one's religious and moral convictions, while the right to an equal

education refers to the decrease in inequality in the approach to education which affects poor children, children with disability or developmental issues, or groups exposed to discrimination (Rabin, 2007; cited in Vuković, 2017, p. 133).

These rights are stated in the *Law on the Fundamentals of the Education System of the Republic of Serbia* (2021). Primary education in Serbia is compulsory and free, while secondary education is free, but not compulsory. Article 3 of this *Law* cites that “every person shall have the right to education” and that the “the citizens of the Republic of Serbia shall be equal in exercising their right to education and pedagogy”. It also states that a “person with developmental impairments and disabilities shall be entitled to education and pedagogy which takes into consideration their educational needs within the regular education and pedagogy system, within the regular system with individual or group additional assistance or in a special group or school”. An individual with exceptional abilities “shall be entitled to education which takes into consideration their special educational needs, within the regular system, within special classes or within a special school”. Article 7 outlines the general principles of education, where it is also indicated that a system of education and pedagogy must be provided for all children, learners, and adults, along with “equality and accessibility of education and pedagogy based on social justice and the principle of equal opportunities without discrimination”, as well as a “balanced high-quality education and pedagogy, based on the achievements of modern sciences”.

Following the introduction of compulsory and free primary education¹ (1952), there was an expansion of secondary, higher, and high education, as well an improvement in the educational structure of the population. However, as pointed out by Matejić Đuričić and Filipović, a higher education does not mean the same as education for all, since an expansion of education leads to a “recomposition” of inequality, and the social differences among individuals and groups do not disappear but are delayed (“postponed elimination”) (2014, p. 93). The results of their study *Expansion of education: the reality and appearance of equal opportunities in education* (in Serbian: *Ekspanzija obrazovanja: realnost i privid jednakih šansi u dostupnosti obrazovanja*) confirms this, and also confirms Bourdieu’s hypotheses on education “reproducing” inequality. In order to answer the question why under conditions of a structural crisis the significance of the ascribed (“inherited”) features increases, while the significance of personal achievement decreases, the key concepts that were used were segregational democratization and cascade competition, along with an annulment of the democratic principle of equal opportunities. Opportunities in terms of the accessibility of education were tested at the level of entry into the education system, the diversification of the educational process, and the social valorization of the acquired diplomas (2014, p. 87–103).

The social context in which the evaluation of the state of the education system, the accessibility of education, and the (in) equality of educational opportunities are studied, along with the knowledge acquired and skills developed during education for the inclusion of individuals from various social groups in the job market, is the economic, political, and social crisis which began in the 1980s. The crisis escalated at the beginning of the 1990s, and its long-term and synergetic effects today are reflected in all the aspects of life and work in Serbia, its institutions, and its citizens.

The significance of research into the state of the education system, the availability of education, and the (in)equality of educational opportunities for members of various social groups in Serbia is reflected in the fact that it allows future analysts to gain insight into various social aspects pertaining to education. Mapping certain problems in the education system and comparing education trends in Serbia with those of other European countries could provide the basis for the creation of public policy which might contribute to their solution.

¹ A compulsory eight-year education was introduced in 1952 in the *General Education Law*.

Research Questions

The main research question refers to how the citizens of Serbia rated the state of education as a whole, the accessibility, and the significance of education in Serbia. This research question includes the answers to the following questions:

1. What are the results of the evaluation of the state (quality) of education as a whole in Serbia?
2. What are the results of the evaluation of the existence of equal/fair opportunities for the desired level of educational attainment in Serbia for each interviewee?
3. What are the results of the evaluation of the existence of equal/fair opportunities for the desired level of educational attainment for every citizen?
4. What are the results of the evaluation of the significance of the knowledge acquired and skills developed for deciding whether a person should or should not be given a job in Serbia?

Research Methodology

General Background

The European Social Survey (ESS) was carried out in Serbia in 2018/2019, financed from national and European sources – The Ministry of Education, Science and Technological Development and the Swiss foundation for development and cooperation HELVETAS, via the “PERFORM” project. Databases containing the compiled data were published in May 2020 on the official website of the ESS².

The ESS is the study of social attitudes, beliefs, and the behavior of individuals in European countries. Over the past eight cycles 37 countries participated in it, while 29 participated during the ninth cycle, along with Serbia which was included for the first time. The quality of the data compiled as part of this study, which enjoys an international reputation, is considerable. The data is used by the European Commission, national governments, political analysts, advisory bodies, politicians, journalists, researchers, and students. The study was carried out in accordance with the highest methodological protocols (the approach used to determine the sample, the response rate, design of the questionnaire, the field protocol, etc.)³ so that the data from all the countries taking part in the ESS could be compared.

Research into the state and availability of education in Serbia relies on the functionalist theoretical perspective of viewing education as the preparation of an individual to perform certain social roles and assume their position on the social hierarchical ladder (Durkheim, 1981), as well as the tenets of the theory of educational capital which refer to the mechanisms and reproduction of social inequality in education (Bourdieu and Passeron, 1977). Therefore, the initial assumptions of the research were: a) that there is a small prevalence of high grades regarding the state (quality) of education as a whole, the accessibility, and significance of education in Serbia, and b) that perceptions of education differ depending on some of the socio-demographic characteristics of the interviewees (gender, age, level of educational attainment, type of job of the interviewee, regional belonging).

Sample

The interviewees who made up the sample were citizens of Serbia over the age of 15. The sample was compiled in 2018 and is based on data from the Statistical Office of the Republic of

2 The databases, questionnaire and a description of the data compilation are available at: <https://www.europeansocialsurvey.org/data/country.html?c=serbia>; the validity is available at: https://www.europeansocialsurvey.org/methodology/ess_methodology/data_quality.html; and ponder (weights) at: https://www.europeansocialsurvey.org/methodology/ess_methodology/data_processing_archiving/weighting.html

3 For more details on the research see: www.europeansocialsurvey.org

Serbia obtained from the last Census held in 2011. The data referred to households, and covered almost all the municipalities in Serbia. The sample was compiled based on the addresses of 3605 households. The Statistical Office of the Republic of Serbia created a representative list of potential interviewees based on a random sample containing data on the households in Serbia, and the total number of interviewees from Serbia was 2043. If the interviewee was under the age of 16 during the interview, the parents or guardians were asked for permission for participation. The parents/guardians also had the opportunity to ask to view the questionnaire beforehand.

The ESS is led by the principle that samples must be representative for all individuals over the age of 15 (without an upper age limit), who live in private households in each country the study is being carried out in, irrespective of their nationality, citizenship, or native language. The interviewees are selected by rigorous methods of random probability and all the countries must strive for the minimum “effective achieved sample size” of 1.500, or 800 in countries with a population of less than 2 million.⁴

Instruments and Procedure

The research instrument was a standardized questionnaire, and the survey was carried out by trained interviewers during face-to-face interviews. The interview lasted approximately one hour. Considering that this study adheres to the highest methodological standards, the training of the interviewers was quite complex. The interviewers asked questions and noted down the responses to ensure that the differences in the responses reflect the differences in their attitudes and behavior, and not the differences in the way in which they were asked the questions or how their responses were recorded. The European Social Survey adheres to the principle that all the interviewees should receive an equal amount of introductory information, to be in a situation where they could focus on the questions they were asked, and respond without being influenced by anyone and that they should not read the questions themselves. The questions in the survey which referred to the state (quality), availability, and significance of education were of a closed type (multiple choice), while the questions regarding the state (quality) and availability of education were offered to the interviewees in the form of quantitative modalities of grades ranging from 0 to 10. For a more precise analysis and crossed variables they were collapsed into five categories: 1 – unsatisfactory (0, exceptionally poor); 2 – satisfactory (1, 2, 3); 3 – good (4, 5, 6); 4 – very good (7, 8, 9); 5 – excellent (10, exceptionally good).

Participation in the study was voluntary. The interviewees were free to choose which questions they did or did not want to answer, as well as terminate the interview at any point with no explanation. All the personal data of the interviewees are protected⁵ in accordance with the Data Protection Law, while access to the data compiled during the study was only granted to researchers who applied for it and were given permission, and who also signed non-disclosure agreements⁶.

⁴ A professional committee was in charge of the sampling and the pondering. Each of the national coordination teams was responsible for a sample design which adhered to the sampling principles of the ESS suited for use in their country, and to that effect they had the support of a member of the Sampling and Weighing Expert Panel of the ESS. For more on the principles of sampling in the ESS and sampling guidelines see: https://www.europeansocialsurvey.org/docs/round9/methods/ESS9_sampling_guidelines.pdf

⁵ A complete notification on privacy is available at: www.europeansocialsurvey.org/about/privacy.html

⁶ The study procedure and data control were carried out by The European Social Survey European Research Infrastructure Consortium (ESS ERIC) whose headquarters are in London (Great Britain). The individual in charge of carrying out the study and data control in Serbia is D. Stanojević, PhD as the National coordinator, the Institute for Sociological Research of the Faculty of Philosophy, University of Belgrade, ESS ERIC is the Data Controller, while the national institution in charge of data protection is the Commissioner for Information of Public Importance and Personal Data Protection, the Information Commissioner's Office UK.

Data Analysis

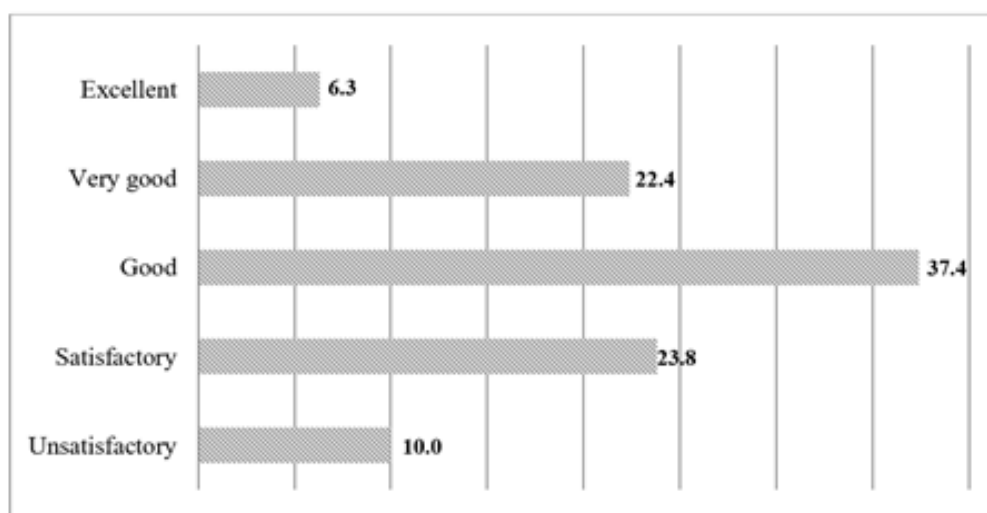
In accordance with the aim of the study, suitable statistical procedures were used to analyze the results. The analysis included descriptive statistics and the determination of basic statistical indicators (frequency distribution and percentages). The statistical significance of the differences in the evaluation of the state of education as a whole, the accessibility, and significance of education based on the socio-demographic characteristics of the interviewees (gender, age, level of educational attainment, job of the interviewee, regional belonging) was tested using χ^2 . The data were processed through the SPSS program for statistical data analysis.

Research Results

The evaluation of the state (quality) of education in Serbia as a whole and its accessibility were viewed through the responses of the citizens (provided in the form of grades ranging from 1 to 5, that is, from an exceptionally poor to exceptionally good education), on the (non)existence of fair opportunities for the desired level of educational attainment for each interviewee, and the (non)existence of the opportunity for the desired level of educational attainment for every citizen. In addition to these indicators of the state and accessibility of education, the significance of education as a factor which could contribute to successful employment was also taken into consideration, and the citizens were asked about the importance of individual factors (the knowledge acquired, and the skills developed during education; connections to someone in the organization in question) when seeking employment in Serbia. Figure 1 presents the evaluation of the state (quality) of education in Serbia based on five modalities: unsatisfactory (exceptionally poor), satisfactory, good, very good, and excellent (exceptionally good).

Figure 1

An Evaluation of the State of Education as a Whole in Serbia (%)



When it comes to the evaluation of the state (quality) of education in Serbia, the results confirm the initial hypothesis that in the highest grade would only be found in the smallest percentage (6.3%) (grade 5, excellent). That the state of education is very good (grade 4) was also the evaluation of a small percentage of the citizens (22.4%). Based on the opinions of

most interviewees (37.4%), the state of education in Serbia is good (grade 3). However, when we compare the results below and above the mid-range values (grade 3), we can note a greater prevalence of grades below it, indicating that the state of education is poor (exceptionally poor 10.0% and satisfactory 23.8%).

The accessibility of education was evaluated based on the equal/fair opportunities for one's own level of educational attainment and the equal/fair opportunities for the level of educational attainment of other citizens. The results of the evaluation from the point of view of the interviewees' own experience, that is, whether during their education the interviewees had equal/fair opportunities for their desired level of educational attainment, compared to the other people in their environment, are shown in Figure 2.

Figure 2

An Evaluation of the Accessibility of Education (the Existence of Equal/Fair Opportunities for the Desired Level of Educational Attainment) Based on Personal Experience (%)

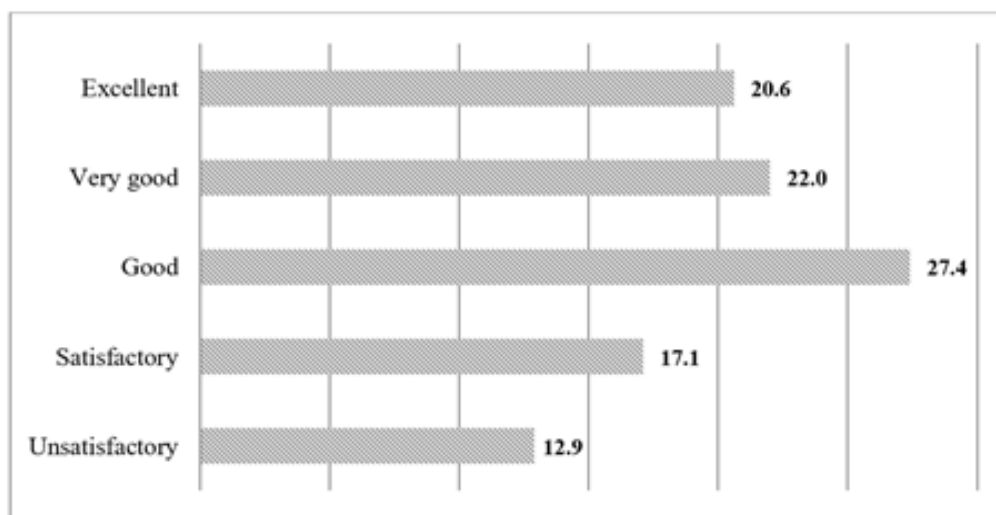


The evaluations of the interviewees based on their own experiences during education indicate that only one-third (34.7%) had completely equal/fair opportunities (grade 5, excellent) for the desired level of educational attainment. Based on the results above the mid-range point (grades very good and excellent), it could be noted that 55.8% of the interviewees confirmed that there were equal opportunities for the desired level of educational attainment, which indicates that almost every other interviewee in Serbia did not have these opportunities.

Figure 3 shows how the interviewees evaluated the accessibility of education, that is, the existence of equal/fair opportunities for their desired level of educational attainment for each citizen of Serbia.

Figure 3

The Evaluation of the Accessibility of Education (the Existence of Equal/Fair Opportunities for the Desired Level of Educational Attainment for Every Citizen of Serbia) (%)

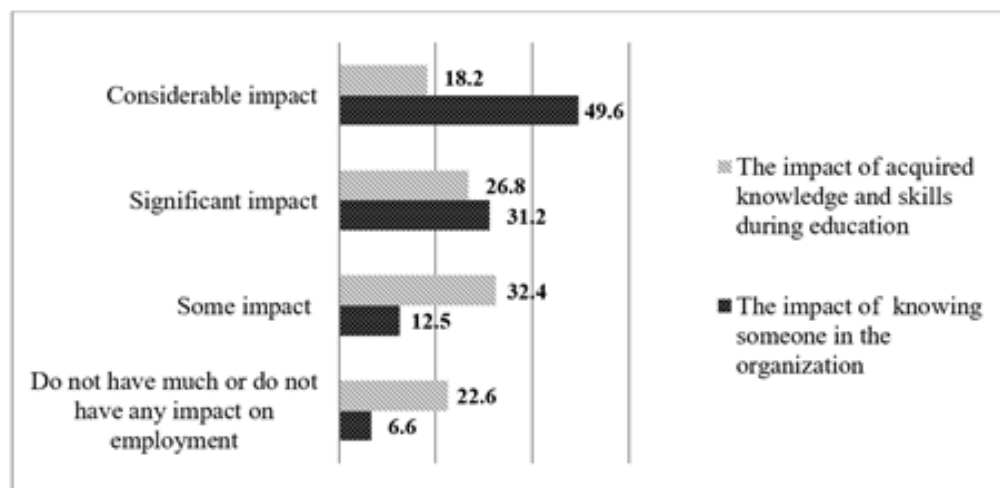


The distribution of the results is similar to that of the results of the evaluation of the opportunities of the people in our environment for attaining their desired level of education. Based on the evaluations of the interviewees, only 20.6% had completely (grade 5, excellent) equal/fair opportunities. In addition, an analysis of the results above the mid-range point (very good and excellent) indicates that less than one-half of the interviewees (42.6%) believe that other people had equal/fair opportunities during their education. It is noteworthy that the highest grade for the existence of equal/fair opportunities (grade 5, excellent) is more prevalent in the case of one's own personal experience, indicated by the interviewees stating that they had more positive experiences attaining their desired level of education compared to other people in Serbia. These findings can be the starting point for new socio-psychological studies of the perception of social inequality in education.

When it comes to the evaluation of the significance of education (knowledge acquired and skills developed during the course of education) for inclusion in the job market and for employment, the results (Figure 4) indicate that the smallest percentage of citizens believe that they have a considerable impact when seeking employment (18.2%), while 22.6% of the interviewees believe that knowledge and skills do not have much of an impact or that they do not have any impact on employment at all. A significantly greater percentage of interviewees stated that knowing someone in the organization of choice has considerable impact on employment (49.6%).

Figure 4

The Evaluation of the Impact that the Knowledge Acquired and Skills Developed or Knowing Someone in the Organization Have on the Decision of Who Will Be Given a Job in Serbia (%)



The aforementioned results confirm the initial hypotheses of the low prevalence of high grades for the state (quality) of education as a whole, the accessibility, and significance of education in Serbia.

Socio-demographic Characteristics and the Evaluation of the State, Accessibility, and Significance of Education in Serbia

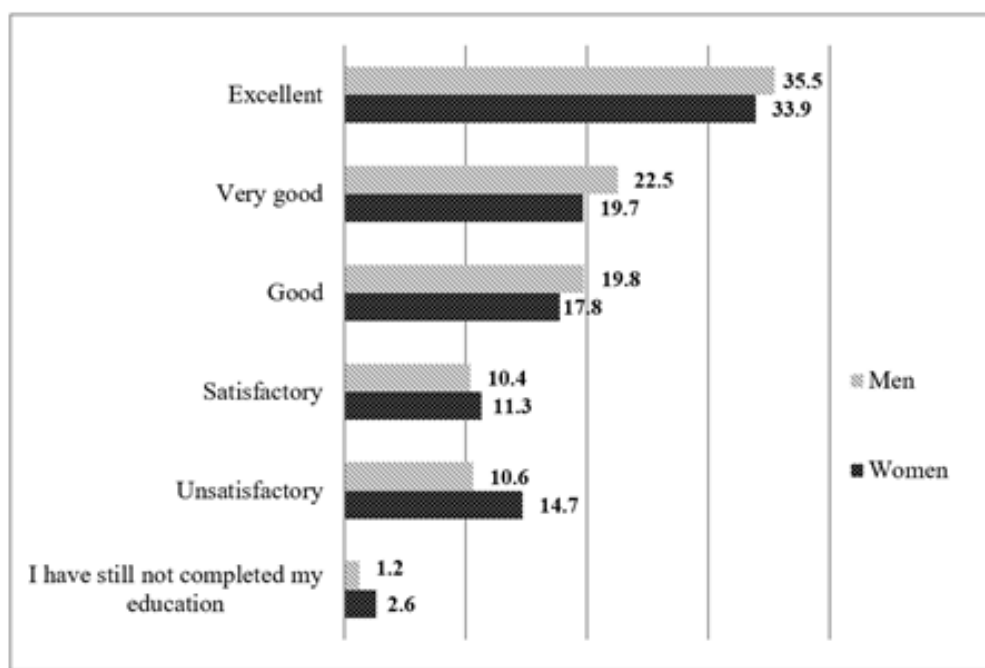
One of the aims of this paper was to determine the association between the socio-demographic characteristics of the interviewees (gender, age, level of educational attainment, type of job of the interviewee, regional belonging) and the evaluation of the state, accessibility, and significance of education in Serbia. The initial hypothesis was that the perception of education differed depending on these characteristics, that is, that there is a statistically significant association between certain socio-demographic characteristics of the interviewees and the evaluation of the state, accessibility, and significance of education.

The results indicate that, when it comes to gender, there are statistically significant differences ($\chi^2 = 14.94$, $df = 5$, $p = .01$) when evaluating the existence of equal/fair opportunities for attaining the desired level of education based on one's own experience (Figure 5), while when it comes to the evaluation of the state of education in Serbia, as well as the evaluation of the existence of opportunities for every citizen in Serbia for the desired level of educational attainment, there is no statistically significant association with gender.

Based on the findings, female interviewees consider that they did not have equal/fair opportunities for the desired level of educational attainment (equal/fair opportunities do not exist – 14.7%), as well as that equal/fair opportunities existed to a small extent (grade 2, satisfactory – 11.3%). On the other hand, the male interviewees gave grades of 3, 4 and 5 (good, 19.8%, very good 22.5% and excellent 35.5%) to a greater extent than the female interviewees.

Figure 5

Evaluation of the Existence of Equal/Fair Opportunities for the Desired Level of Educational Attainment Based on Personal Experience / the Gender of the Interviewees (%)



When it comes to the age of the interviewees, the results indicate an interesting distribution of the responses when evaluating the state of education as a whole (Table 1).

Table 1

Evaluation of the State of Education in Serbia / the Age of the Interviewees (%)

Evaluation of the state of education in Serbia	The age of the interviewees							Total
	15–24	25–34	35–44	45–54	55–64	65–74	75+	
1 – Unsatisfactory (exceptionally poor state)	9.6	8.7	14.3	11.6	10.5	8.0	7.1	10.1
2 – Satisfactory	22.9	31.6	31.2	28.0	22.5	18.3	13.3	23.8
3 – Good	41.4	34.0	36.1	36.0	39.5	36.9	38.7	37.4
4 – Very good	22.9	20.9	14.7	20.5	22.0	26.5	29.3	22.4
5 – Excellent (exceptionally well)	3.2	4.9	3.8	3.9	5.5	10.3	11.6	6.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

While the age groups 35–44 (14.3%) and 45–54 (11.6%) predominantly opted for grade 1 (unsatisfactory, exceptionally poor state), grade 2 (satisfactory) was predominantly the choice of the age group 25–34 (31.6%), more so than it was of the other groups. However, the most prevalent grade, grade 3 (good), was given by the youngest age group 15–24 (41.4%). And finally, the highest grades when evaluating the state of education in Serbia were given by the oldest age groups of interviewees. Grade 4 (very good) was given by the age group of 75 and over (29.3%) and the age group 65–74 (26.5%), while grade 5 (excellent, exceptionally well)

was given by the age group of 75 and over (11.6%) and the age group 65–74 (10.3%).

When it comes to association between the variable of age and the (non)existence of equal/fair opportunities for the desired level of educational attainment, the results indicate that there is a difference in the opinions of interviewees regarding whether each citizen of Serbia has an equal/fair opportunity for attaining the level of education they want (Table 2).

Table 2

Evaluation of the Accessibility of Education – the Existence of Equal/Just Opportunities for the Desired Level of Educational Attainment for Each Citizen of Serbia / Age of the Interviewees (%)

The opportunity for the desired level of educational	The age of the interviewees							Total
	15–24	25–34	35–44	45–54	55–64	65–74	75+	
1 – Unsatisfactory (there are no equal/fair opportunities)	10.2	18.6	14.6	15.7	12.4	10.5	8.7	12.9
2 – Satisfactory	18.5	20.1	21.3	20.2	14.0	15.4	11.7	17.0
3 – Good	29.9	27.9	23.6	24.7	31.6	27.0	26.5	27.3
4 – Very good	26.8	18.1	22.1	23.2	21.2	22.6	20.9	22.0
5 – Excellent (there are completely equal/fair opportunities)	14.6	15.2	18.4	16.3	20.7	24.4	32.2	20.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The findings confirm that age is a significant determinant of the perception of the (non) existence of equal/fair opportunities for the desired level of educational attainment in Serbia. Namely, most of the interviewees who consider that there are no equal/fair opportunities (grade 1) belong to the age group of 25–34 (18.6%), while the greatest prevalence of grade 2 (satisfactory) was determined among the age group of 35–44 (21.3%). Grade 3 (good) was mostly given by interviewees aged 55–64 (31.6%), while grade 4 (very good) was given by the youngest interviewees of 15–24 (26.8%). That there were completely equal/fair opportunities for the desired level of educational attainment (excellent) was confirmed by most of the oldest interviewees who belong to the age group of 75 and over (32.2%) and the age group 65–74 (24.4%).

The analysis of the results indicates that the evaluation of the state (quality) of education differs depending on the level of education of the interviewees ($\chi^2=1.50$, $df=20$, $p=.00$) and that interviewees with a lower level of education evaluated the state of education more positively (Table 3).

Table 3

Evaluation of the State (Quality) of Education / the Level of Education of the Interviewees (%)

Evaluation of the state (quality) of education	The level of education of the interviewees						Total
	No education and an incomplete primary education	Primary education	Secondary education and high school	Academic development after secondary education and high school	University or college education	Postgraduate studies (specialist degree, master's thesis, doctoral dissertation)	
1 – Unsatisfactory (exceptionally poor state)	11.9	6.9	10.5	11.3	12.5	4.3	10.1
2 – Satisfactory	8.2	16.7	23.8	29.8	37.0	38.6	23.8
3 – Good	34.0	34.1	38.6	40.5	37.0	34.3	37.3
4 – Very good	28.9	29.0	22.8	14.9	11.5	21.4	22.4
5 – Excellent (exceptionally well)	17.0	13.2	4.3	3.6	2.0	1.4	6.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Compared to the other interviewees, the greatest prevalence of grade 1 (exceptionally poor, unsatisfactory) was determined among the group of interviewees with a high level of education (12.5%), while grade 2 (satisfactory) was most prevalent among the interviewees who completed their post-graduate studies (specialist degree, master's thesis, doctoral dissertation) (38.6%). The average grade of 3 (good) was most prevalent among interviewees who had professional training after secondary school and those with a higher level of education (40.5%). The highest grades of 4 and 5, very good and excellent, were given by interviewees with a primary education (very good, 29.0%), without an education or with an incomplete primary education (excellent, 17.0%). Diagonally, an almost perfect distribution of grades from lower (1, 2) to higher (4, 5) is associated with a decline in the level of education of the interviewees, from high levels of education and postgraduate studies (1, 2) to lower levels of education (4, 5).

Table 4 shows the results for the differences which exist when evaluating the personal opportunities of the interviewees for the desired level of educational attainment based on their existing level of education ($\chi^2=4.34$, $df=25$, $p=.001$).

Table 4

Evaluation of the Availability of Education – the Existence of Equal/Just Opportunities of the Interviewee for the Desired Level of Educational Attainment / Level of Education of the Interviewees (%)

Evaluation of the existence of fair opportunities for the desired level of educational attainment	The level of education of the interviewees						Total
	No education and an incomplete primary education	Primary education	Secondary education and high school	Academic development after secondary education and high school	University or college education	Postgraduate studies (specialist degree, master's thesis, doctoral dissertation)	
1 – Unsatisfactory (there are no equal/fair opportunities)	40.5	25.9	8.2	5.3	2.0	-	12.7
2 – Satisfactory	24.3	15.9	10.4	2.4	3.9	2.8	10.9
3 – Good	17.3	18.4	22.1	13.6	12.7	4.2	18.7
4 – Very good	8.1	16.5	23.1	27.2	24.0	19.7	21.0
5 – Excellent (there are completely equal/fair opportunities)	8.7	21.2	33.8	51.5	56.4	73.2	34.8
I have still not completed my education	1.2	2.2	2.4	-	1.0	-	1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Even when it comes to the accessibility of education, what is interesting is the distribution of the responses of the interviewees which indicate that in this case, as in the previous one, a pattern can be discerned. Namely, that there were no equal/fair opportunities for the desired level of educational attainment (grade 1, unsatisfactory) was confirmed mostly by interviewees with no education and an incomplete primary education (40.5%), while the highest grade of 5 (excellent, completely exists) was given by interviewees with the highest levels of educational attainment (specialist degree, master's thesis, and doctoral dissertation) (73.2%).

The findings that refer to the association between the type of job which the interviewee has and the evaluation of the state (quality) of education show that there is some difference in the answers. The results show that among the studied categories of (un)employment (a paid position; is attaining an education; unemployed, looking for work; unemployed, not seeking work; permanently ill or disabled; retired; does housework, takes care of children, etc.; other), the lowest grade 1 (unsatisfactory, exceptionally poor) was given by interviewees who are unemployed and seeking employment (9.7%), while the highest grade 5 (excellent, exceptionally good) was given for the state of education by pensioners (53.2%).

An analysis of the findings (Table 5) which refer to the evaluation of the accessibility of education also indicates that the interviewees differ in their evaluation of accessibility of education in relation to their job.

Table 5

Evaluation of the Availability of Education – the Existence of Equal/Just Opportunities of the Interviewee for the Desired Level of Educational Attainment/Job of the Interviewee (%)

The type of job of the interviewee	Evaluation of the accessibility of education (the existence of equal / fair opportunities for the desired level of educational attainment)						Total
	1 – Unsatisfactory, (there are no equal/fair opportunities)	2 - Satisfactory	3 - Good	4 – Very good	5 – Excellent, (there are completely equal/fair opportunities)	I have still not completed my education	
Gainful employment	15.0	22.8	37.0	43.3	38.5	18.9	34.2
Is getting an education	1.2	1.9	2.9	6.9	6.0	70.3	5.7
Unemployed, seeking employment	7.5	8.4	7.5	6.7	5.5	-	6.6
Unemployed, not seeking employment	4.0	5.6	4.8	3.1	4.6	2.7	4.3
Permanently ill or disabled	5.5	1.4	1.9	2.1	0.7	-	1.9
Retired	44.3	40.5	35.9	28.1	34.8	5.4	34.9
Housework, taking care of children, etc.	19.0	18.6	7.5	7.9	7.0	2.7	10.0
Other	3.6	0.9	2.4	1.9	2.9	-	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Compared to the other categories of interviewees, the highest grade 5 (excellent), that is, confirmation that they completely had equal/fair opportunities for the desired level of educational attainment was given by employed interviewees (who are currently working) (38.5%). On the other hand, the lowest grade of 1 (unsatisfactory, does not exist at all) was given by interviewees who are retired (44.3%), interviewees doing housework, taking care of children and the like (19.0%), as well as those permanently ill or disabled (5.5%).

When it comes to the regional belonging of the interviewees as the determinant of the evaluation of the state and accessibility of education, the results indicate that there are statistically significant differences among interviewees originating from various regions of Serbia (the Belgrade Region, Vojvodina Region, Šumadija Region, the Region of West Serbia, and the Region of South and East Serbia). What is interesting is that the lowest grades for the state (quality) of education of 1 and 2 (unsatisfactory and satisfactory), compared to the interviewees from other regions, were given by interviewees from the most developed Belgrade Region (12.3% and 32.0%), while grade 3 (good) was given by interviewees from the least developed Region of South and East Serbia (42.2%).

Discussion

The findings regarding the perceptions and evaluation of the state (quality) of education as a whole, the accessibility, and the significance of education in Serbia confirmed the hypothesis on the awareness of the citizens regarding the problems in education, considering that only 22.4% of the citizens rated the state in education as a whole as very good (grade 4), and 6.3% as excellent (grade 5). When it comes to the accessibility of education to the citizens of Serbia, the results indicated that based on personal experience of whether they had equal/fair

opportunities for the desired level of educational attainment, only 34.7% of the interviewees stated that they had completely equal/fair opportunities (grade 5, excellent). That there were equal/fair opportunities for each citizen of Serbia to attain their desired level of education (grade 5, excellent) was confirmed by only 20.6% of the interviewees. The results showed that, based on the grades given by the interviewees, education does have an impact when seeking employment, but that having a connection with someone who is already employed in the organization where one is seeking employment had the greatest impact on obtaining a job (as many as one-half of the interviewees included in the study considered such connections to have considerable significance).

The results of the analysis of the opinions held by citizens of Serbia regarding education, which was carried out four years earlier (2015)⁷, showed that most citizens did not see education as an important problem in Serbia, and were mostly preoccupied with existential issues such as unemployment and low living standards. Education as one of the most important problems was cited by a very small number of citizens, mostly those with a higher level of educational attainment, as well as citizens whose children were attending university. However, the fact that the citizens did not cite education as one of the most important problems in the country does not mean that they are not aware of the existing problems in the education system, or that they are satisfied. To the question of whether they are satisfied with the education system in Serbia, every other interviewee replied that they were not satisfied, and most of the dissatisfied individuals had a high level of educational attainment. When it comes to the shortcomings of education in Serbia, the interviewees mostly cited lack of practice, the poor quality of the educational program, lack of interest on the part of the teachers, and an extensive workload. The highest grades were given to primary education (two-thirds of the citizens included in the study evaluated this level of education with a positive grade), while secondary education was given the lowest grade. A noteworthy point is that highly educated interviewees gave the lowest grades to the education system on all levels, while those with a lower level of educational attainment provided more positive evaluations of the system of education in Serbia. These findings are congruent with the results of the state (quality) of education in Serbia from 2019 and indicate the necessity of implementing suitable measures to bring education in Serbia to a higher level.

When it comes to the significance of education (the impact of the knowledge acquired and skills developed for inclusion in the job market and employment), the results are similar to the findings of the aforementioned study from 2015. Based on the opinion of the interviewees regarding employment, a connection with someone who could sway an employer was also considerably important, while the knowledge acquired, and skills developed during education were of a lower significance (a university degree). On the other hand, in addition to the aforementioned shortcomings of the education system in Serbia, almost two-thirds of the interviewees pointed out that they believed that young people who graduated from university in Serbia were qualified to perform the tasks they were educated to do.

The *OECD Review of Evaluation and Assessment in Education: Serbia* of the OECD and UNICEF showed that the attempts to raise education to a higher level were questionable due to the limited institutional capacities and low public expenditure on education (2020, p. 5). Even though the extent of the scope increased significantly, it differed based on socio-economic groups and regions. This referred to all the levels of education, and especially those that were not compulsory. For example, in 2008 only 7% of learners from the poorest families were attending preschool, as opposed to 64% of learners from more affluent households (Pešikan & Ivić, 2016; as cited in *The OECD Review*, 2020, p. 9). In addition, when it comes to achievements, PISA

⁷ The study was carried out on a sample of 1007 interviewees aged 18 and over in 67 municipalities, including urban, suburban, and rural environments, and was initiated and carried out by the Social Inclusion and Poverty Reduction Unit (SIPRU) of the Government of the Republic of Serbia.

findings from 2018 indicated that in Serbia learners from more vulnerable families were behind their peers from wealthier families in terms of literacy by approximately two years (a difference of 73 points) (as cited in *The OECD Review*, 2020, p. 9).

In Serbia, like in some other countries in the region, there were geographical differences which were reflected in the fact that learners who lived in rural areas had a smaller opportunity of being included in the education process and of finishing school. For example, in 2013 the decline rate for attaining primary education in urban areas was 1%, and in rural areas was 14.25% (Pešikan, 2015). In addition, the achievements of learners in rural areas were lower. Learners attending schools in urban environments in Serbia had 122,3 points more on the PISA literacy test than students attending schools in rural areas. It is important to point out, when it comes to the education of the Roma, that children of the Roma nationality have a far smaller chance than other children of attending school, getting a higher education, and of making advancements in their education, especially if they live in poverty. In a study carried out by UNICEF it was determined that only 4.7% of children from the poorest families in the Roma settlements in Serbia attended secondary school, as opposed to the almost 40% of children who lived in more favorable socio-economic environments (*The OECD Review* 2020, p. 9, 10). This perpetuates the vicious cycle of reproduction of poverty and of children in poor families being denied the opportunity of developing their potential, which their peers from families with a higher socio-economic and educational status have. Therefore, investing in the education of children with a lower socio-economic status is not just a moral obligation, but an investment in their future and the development of all society. "Education is widely accepted as the main exit route from poverty. It is the backbone of growth and development of individuals and the nation. However, its achievement continues to elude many who are poverty stricken. This has perpetuated the vicious circle of poverty, it is most common in developing countries, particularly in rural areas, although pockets of poverty also exist in developed countries. Extreme poor are denied access to education, poverty hampers learning in developing countries through poor nutrition, health, home circumstances (lack of books, lighting, or places to do homework), access to education, quality, costs, and inadequate resources for education" (Julius & Bawane, 2011, p. 82). The lack of accessibility of education for children from poor families and unequal opportunities during the course of their education later hinder employment and make it impossible to earn a greater income. On the other hand, the social implications of such social inequality in education are greater social and health expenditure, the weakening of social cohesion, and the lack of possibility for sustainable economic and social development.

Based on the data from the *Statistical Office of the Republic of Serbia*, the number of children in preschool educational institutions in Serbia increased from 2011 to 2018, but considerable regional differences were prevalent. The greatest scope was in the Region of Belgrade (65.9%), while it was considerably lower in the Region of South and East Serbia (47.1%). In the seven municipalities which belong to devastated areas, the scope was even smaller. Over this period there was an insignificant increase in the number of primary school institutions (from 1.113 to 1.132) and mostly in the urban settlements in the Region of Belgrade, while over the same period of time the number of four-grade primary schools decreased by 7.1% (from 2.354 to 2.187) in rural environments. In addition, we could also note a decrease in the number of learners over the same period, which was a consequence of the low birth rate, ageing of the population, and immigration due to unsatisfactory socio-economic circumstances. It could also be noted that a great number of young people in Serbia did not continue their education following the completion of their primary school education (the percentage of the population aged 18–24 with at most a primary school education was 16.9%), and that regional differences existed there as well. Based on the results of the last *Census of 2011*, more than one-sixth of young people did not continue their secondary education, and most of the young people among them were from rural environments (SORS, 2018).

Even though the reform of the education system in Serbia, following the stagnation in the social development at the end of the 20th century, also included a reorganization in terms of the democratization of educational activities (providing the opportunity for accessible education for everyone)⁸, the cited results indicated that more adequate and effective solutions were needed for the democratization of education in Serbia.

The second proposed hypothesis, that there is a difference in the evaluation of the state (quality) of education as a whole, the accessibility, and significance of education in Serbia depending on some of the socio-demographic characteristics of the interviewees (gender, age, level of educational attainment, the job of the interviewee, regional belonging), was also confirmed. Under the *Law on the Fundamentals of the Education System of the Republic of Serbia* (2021, article 3 and article 6) it is stated that the system of education must provide equal right and accessibility of education and pedagogy without discrimination and segregation based on gender, place of residence, material, or health status among others, for all children, learners, and adults. The *Act on the Prohibition of Discrimination* (2009) also cites discrimination in the field of education and professional development as a special form of inequality. Under this act everyone has the right to an education (preschool, primary, secondary, and high education), as well as to professional instruction under the same conditions. It is against the law to make it more difficult or impossible for an individual or a group of individuals to enroll in an educational institution based on one or more of their personal features, for them to be excluded from these institutions, and to make it difficult or impossible for them to attend class or take part in any other educational activities (article 19). The *Act on Gender Equality* (2009, article 30), among other things, states that educational and scientific institutions and institutions for professional education must not discriminate based on gender, especially when it comes to: the enrollment criteria and rejection criteria of an institution; the opportunity to access continued education, including all educational programs for adults and programs for functional literacy; assessment of knowledge and evaluation of the achieved results; the conditions for acquiring scholarships and other forms of assistance for education and study; the requirements for advancement or acquisition of a title, career focus, professional development and earning a degree; the requirements for advancement, further qualifications or requalification.

However, based on the findings of studies which were analyzed, females, compared to males, more often believed that they did not have fair opportunities for their desired level of educational attainment compared to other people. They confirmed the existence of certain inequalities in education which women perceived to a greater extent compared to men. Traditional norms which refer to the different relationships towards male and female children, where greater importance is ascribed to male children and their progress in various spheres of social life (education, employment, the economy), have been retained in Serbia to this day, so that women are faced with the gender differentiation of relationships from early childhood (a different attitude when bringing up male and female children, giving an advantage to male children). It is a well-known fact that during the 20th century, female children attended primary (compulsory), secondary and higher education institutions much less, and this occurrence was not frowned upon in the social environment, but was instead accepted and justified with reasons such as: their greater focus on household activities, taking care of children, food preparation, care for the elderly and the like. This is especially pronounced in rural environments, and among lower and more poor strata of society.

When it comes to the age of the interviewees and the evaluation of the state of education as a whole in Serbia, the distribution of responses could only be explained by the various experiences of the generations of interviewees and a critical approach to education. The middle generation (the generation of the parents, 35-54 years of age) encountered numerous problems

⁸ Starting from the academic 2010/2011 schoolyear, the inclusive approach has been used in the education system of Serbia.

during their education and employment at the crossroads between two centuries, at a time of intense social and economic turmoil (the inability to find employment, the transformation of the social system and the like), when the education system itself was caught up in big changes. Many of them faced the following question – what the purpose of an education is when the economic system “rejects” you and when you are unable to apply your knowledge in a practical sense. This is why their negative experiences can be viewed through the predominantly low grade (1, unsatisfactory), that is, the evaluation of education as exceptionally poor. On the other hand, grade 3 (good), was most prevalent among the youngest interviewees (15-24 years of age), which is understandable considering the fact that they were still learners, and still did not have enough experience and a clear perspective for evaluating the state of education. The oldest generation (the generation of the grandparents) when evaluating the state of education to the greatest extent, compared to the other age groups, gave the highest grades (4 and 5, very good and excellent). Considering the fact that they attended school during socialism and that after completing their education they were able to gain employment rather quickly, their perception and evaluation of the state of education, which at the time was a significant channel of social mobility which also denoted the possibility of better quality of life, did not change significantly to this day.

The results confirmed that age was a significant determinant in the evaluation of the (non)existence of equal/fair opportunities for the desired level of educational attainment in Serbia. They indicated that younger middle-aged and middle-aged interviewees were more critical in their evaluation of the opportunities for the desired level of educational attainment, and as a result were more rigorous when grading (a greater prevalence of lower grades, 1 and 2). This can in part be explained by the fact that during the education process, towards the end of the 20th and beginning of the 21st century, we were already facing various forms of social inequality in education (inequality at the onset of education, the inability to enroll in the desired school/university, and the like). However, the fact that the youngest interviewees to the greatest extent evaluated the chances for the desired level of educational attainment as very good, while the oldest interviewees evaluated it by giving an excellent grade, can be accounted for by the lack of experience of those who were still in school (the youngest interviewees), and the positive experience of the oldest interviewees who were educated during the 20th century (prior to the socialist transformation), when the system of education functioned differently than it does today. There were various measures available at the time (compensatory measures) for encouraging the education of children originating from the lowest levels of society (student loans were given mostly based on the evaluation of the social status of the family, and not based on academic success as they are today⁹). When it comes to the level of educational attainment, it could be concluded that there is a pattern, and that with the increase in the level of educational attainment, there is a decline in the evaluation of the state (quality) of education. This pattern can in part be explained by the more critical attitude of the highly educated interviewees regarding education, which is understandable considering the fact that they had more experience, that is, that they spent more time (almost two decades of their life) in the education system and saw some of its shortcomings from their personal perspective (the quality of the educational environment, the quality of the teaching/learning process, the quality of grading, the quality of knowledge of the learners/students). On the other hand, interviewees with no education or low levels of educational attainment (incomplete primary education and a primary education) did not have enough experience, gave up on furthering their education very early on (some did not even have the possibility of attending primary school, even though they might have wanted to), so their perception of education was in part the result of an idealization of something that was not accessible to them in their childhood and youth. These were, to the most part, elderly individuals originating from rural environments, of a lower social status, as well as members of the Roma population who were unable to go to school.

9 On the selection process for attaining the right to state aid in education see Mojić, 2012.

An explanation of the findings confirmed the initial hypotheses on the inaccessibility of education to certain social groups, whose end result was precisely giving up on education after primary (compulsory) education, or not taking part in the education process (interviewees with no education). Considering their limited family resources (economic, cultural, and educational capital), they were unable to get an education during their childhood, and so their attitude towards the lack of any equal/fair opportunities for education is understandable. On the other hand, among those who achieved the highest level of education, attitudes on the existence of equal/fair opportunities for education predominate. Therefore, thanks to their family resources, developed social networks, and encouraging family patterns, they were able to choose their educational path, that is, their educational aspirations were achieved, unlike those with a lower level of educational attainment who had no choice, and whose life and educational path were the results of limited family and social circumstances.

An association also exists between the type of job the interviewee has and the evaluation of the state (quality) of education as a whole, and the accessibility of education in Serbia. The distribution of the responses confirmed the initial hypotheses regarding the unequal opportunities for education for certain categories of the population. When it comes to personal experiences of equal/fair opportunities for educational attainment, what stands out is that those who were permanently ill or had a disability, were unemployed, or were individuals who do housework, take care of children or other individuals, as well as pensioners, predominantly gave the lowest grades. These grades indicated the impact of the social context on the possibility of education (pensioners), and that there were certain forms of inequality during their education, which was reflected in the process of inclusion in the job market (the permanently ill and invalids, the unemployed, individuals doing housework, taking care of children or other individuals). The initial hypothesis on regional differences based on the dichotomy of the developed north – undeveloped south, and therefore, the evaluation of the state (quality), accessibility, and significance of education (high grades from the regions which belong to the north of Serbia and the low grades from the regions which belong to the south of Serbia), was confirmed. The results indicated that the interviewees from developed regions of Serbia were considerably more critical of the state (quality) and accessibility of education in Serbia compared to the interviewees from less developed regions. The explanation for this pattern might be based on the lack of knowledge and broader perspective of the interviewees from economically less developed regions. They, to a greater extent, belong to the deprived social strata, which due to poverty did not have the opportunity to travel and see other regions and states, or to receive an education there. Considering the fact older people and people with a lower level of educational attainment live in these regions in greater numbers, compared to the more developed Belgrade and Vojvodina Region, their evaluation of the quality and accessibility of education in Serbia is understandable.

The noted problems indicated by the results could be used to further develop the theoretical-methodological approach for studying the quality of education in Serbia. On the other hand, they could contribute to determining the possibility of associating the results of the study with the practical solutions for the noted problems, that is, defining new directions and recommendations for improving the quality of education in Serbia since “a society can only be considered modern, advanced and developed if it possesses a high-quality education system, therefore education must be inarguably a ‘political priority’. [...] At the present time, it is also important to create mechanisms for the maximum improvement of education, besides contributing the necessary resources” (Bermejo & Góngora, 2009, p. 30).

Conclusions and Implications

The study of the quality and accessibility of education (facing problems and challenges) is of crucial importance for finding the possibilities for improving the democratization of education, which is one of the key factors for the development, prosperity, and modernization of society.

The results confirmed the initial hypotheses on the state (quality), accessibility, and significance of education and are congruent with the previous findings on the (non)equality of education and the opportunities that members of various social strata have for attaining an education. They indicate that Serbian society in the 21st century is still not “open” enough and that there are certain levels of education which are not accessible to all the members of society. The inaccessibility of educational opportunities and a low educational status can lead to social exclusion of an individual, the inability to perform social roles, or achieve economic wellbeing and economic independence. The significance of such findings is reflected in the fact that they could contribute to the broader social community being better informed on the questions and issues regarding quality of education, which could affect the readiness to work on finding their solutions.

With the aim of overcoming the noted shortcomings in education, further comparative quantitative and qualitative studies are needed to confirm the concrete problems and take on solving them by creating suitable social conditions for the improvement and modernization of the educational system both in Serbia and in other countries. The principle of the new philosophy of education of “education for all” is based on the assumptions that mass education provides society with the needed human resources, the needed human potential for the future and for development, and provides the individual with the possibility of assuming a more favorable social position.

Finding solutions to the problem of social inequality in education requires a permanent evaluation of the quality of education, since legal provisions are not sufficient to enable better accessibility and more fairness in education, and instead certain measures and activities are needed for them to be realized successfully in practice. In that sense, it is necessary: a) to promote and support scientific research in the area of education as a high priority and to motivate researchers to focus on this kind of research in greater numbers, and b) to use the results of these studies when formulating educational policies and recommendations for the improvement of the quality of education, taking into consideration the experiences of other countries as well.

With the aim of democratizing education, it is necessary to create favorable circumstances for the improvement of the position of vulnerable categories in education (the Roma, people with disability, the rural population, women in particular) and to prevent them leaving formal education at an early age. A low level of educational attainment, on the one hand, decreases the chances for inclusion in the job market and for employment which leads to poverty, which is transferred generationally, while on the other hand, it increases the risk for the emergence of violence in the family and in partner relationships. Accordingly, it is necessary to introduce changes into the legal framework and to reformulate the measures of protection for vulnerable categories of the population which would facilitate, primarily, their access to higher education, and thus contribute to their greater prevalence in the student population. Changes are also necessary when it comes to the basic criteria for obtaining benefits (tuition, housing, food, scholarships, loans), where in addition to educational success, which now has priority, a significant criterion would also be, first and foremost, the socio-economic status of the family.

In order to achieve a greater accessibility of education and increase the educational attainment level of the entire population, it is necessary for each citizen to have equal access to all the levels and types of education, in accordance with their personal needs and interests. This would enable each individual to develop their abilities and skills irrespective of the socio-

economic conditions and cultural-educational capital of the family.

Therefore, in order for the effects of the democratization of education to increase, a global reform of society is needed, one which requires an organized democratic state, developed economy, and a greater investment in education on the part of the state which would contribute to greater social mobility. This would create more favorable conditions for the improvement of quality and the modernization of education on all levels, and the harmonization of systems of education in Serbia with European principles and values.

Declaration of Interest

The authors declare no competing interest.

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INFLUENCE OF CONTEXT RELATED FACTORS ON SAUDI SPECIAL EDUCATION TEACHERS' UNDERSTANDING OF EVIDENCE, EVIDENCE-BASED, AND EVIDENCE BASED PRACTICES

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Abstract

The complexity of special education and the variability among students Autism Spectrum Disorder (ASD) require special education teachers to make a concerted effort to provide validated supports that contribute to their students' learning outcomes. Among the most important considerations for teachers is the use of teaching practices supported as effective by evidence. There is a broad consensus that the use of Evidence Based Practices (EBPs) can lead to significant improvements for students with ASD and their families. The research to practice gap is widely recognised in special education in relation to the selection and implementation of EBPs, with several studies finding that teachers used unsupported teaching practices as frequently as those supported by empirical evidence. Thus, in order to utilise EBPs, teachers must first understand what EBPs mean and how a particular practice comes to be evidence-based. Aligning with this emphasis and the increasing introduction of EBPs in special education globally, this study explored special education teachers' understanding of evidence, evidence-based, and EBPs in one centre of autism in the Kingdom of Saudi Arabia (KSA). In this study, a qualitative approach was used. Within this approach, a single case study design was adopted. The data were collected from six special education teachers of students with ASD using interviews. The findings revealed that teachers referred to their own individual experiences or the experiences of other teachers as evidence. In addition, they referred to their superiors' advice as being evidence-based and the perceived EBPs as technical tools handed to them by the Centre. This indicated that teachers' understanding of evidence-based, and EBPs was constructed based on the culture of the Centre. The findings of this study suggest several courses of action for future research, and policymakers and teacher education.

Keywords: autism, Evidence Based Practices (EBPs), special education teachers, Kingdom of Saudi Arabia

Introduction

Understanding Evidence Based Practices

The concept of Evidence Based Practices (EBPs) emerged first in the medical field in the 1990s and was later applied to other fields and disciplines such as the social sciences (Reichow & Volkmar, 2011). Research on EBPs related to ASD has been conducted across many fields such as health (Ziviani et al., 2015), psychology (Falzon, et al., 2010) and education (Cook & Odom, 2013). Each field has a different theoretical orientation which makes it difficult to identify one definition of EBPs. Indeed, each field also has its own interpretation and criteria for what constitutes EBPs (Reichow & Volkmar, 2011).

According to Hudson et al. (2016), Evidence Based Practices have “become the most influential policy construct in the field of special education” (p. 34). In reviewing the literature in special education, EBP has been used in two different, but related, ways (Cook et al., 2016). In describing the first way, Cook and Cook (2013) have referred to EBPs as practices (teaching programmes, interventions, instructional strategies) that have been established as being effective through scientific research designed with clear sets of criteria and that have yielded positive results. In this view, EBPs refer to instructional practices driven solely by research evidence. In the second view, originating in the medical field, EBPs in an educational context are decision-making processes that integrate the best available research evidence, teachers' professional judgement, and the goals and values of the students and their families (Spencer et al., 2012). The combination of these distinct sources of influence (i.e., research evidence, professional judgement, and the goals and values of the students and their families) was prominent in the definition of EBPs of the leading organisations in the field of special education in the USA such as American Psychological Association, American Speech and Hearing Association, and National Autism Centre (Spencer et al., 2012). In addition, Spencer et al. (2012) have suggested that EBP involves more than just a focus on selecting instructional practices. They argue it involves a process of selecting, implementing, adapting, and assessing a practice. In selecting a practice, research evidence in conjunction with teachers' professional judgement, the goals and values of the students and their families, and the teaching and learning context must be considered (Cook & Cook, 2016).

The notion of practice has also been understood differently in both views. Cook and Cook (2011, 2013), who use EBPs to refer to specific instructional practices supported by research, stated that practice refers to “an instructional program or intervention with concrete procedures or steps that can be replicated or followed by others” (Cook et al., 2016, p. 5). Furthermore, practices can be both discrete practices (“micro-practices”, which are everyday interventions, strategies, instructions, and techniques), and broad programmes (“macro-practices”, which involve programme design, curriculum development — a complete framework for intervention). The former needs evidence of everyday technicalities, while the latter needs evidence for deciding on a clear framework for the programme's design and implementation (Cook & Cook, 2013). Spencer et al. (2012) have referred to practice as “an outcome of a decision-making process” of “the whole of one's professional activities” relating to the “school, classroom, or individual case” (Spencer et al., 2012, pp. 129–130) rather than a list of a “well-supported practices”. Although they differ in how they conceptualise EBPs, both groups of researchers emphasise the importance of utilizing research evidence regarding which practice to use in teachers' decision-making. Thus, teachers must have a clear understanding of what comprises EBPs and evidence in order to identify these practices (Sciuchetti et al., 2016). In the absence of an understanding of what constitutes EBPs, teachers may continue to use less effective practices (Cook & Cook, 2013).

Evidence and Evidence Based Practices in Autism

Autism Spectrum Disorder (ASD) is a life-long developmental disorder affecting an individual's behaviours, social interactions, relationships, communication, and can be (or not) comorbid with intellectual disability (Volkmar & McPartland, 2014). There is no one typical presentation of ASD (Anderson et al., 2018), and it comes in many forms. Such forms range from mild to severe disruptions to functioning in areas such as language and social skills. These disruptions often accompany repetitive patterns of special interest and behaviour affecting child learning and development (Lai et al., 2014). Therefore, teachers of students with ASD require specialised knowledge and skills to address the varied needs of these students. Moreover, they must be well versed in teaching practices that are effective for students with ASD (Hsiao &

Petersen, 2019; West et al., 2013). Effective teaching practice in this context is often associated with EBPs (Cook & Odom, 2013; Reichow, 2016).

Within the field of autism research, the National Autism Centre (NAC) and the National Professional Development Centre on Autism Spectrum Disorder (NPDC-ASD) in the USA have evaluated research and have reported many practices that have evidence of their effectiveness based on their set of criteria. Each of these agencies has published reports of their findings and has also provided online guides, resources, and material for practitioners to access (Alexander et al., 2015).

Despite the substantial number of EBPs that have been published by the NAC and the NPDC-ASD for the use of teachers, teachers infrequently use these practices and commonly use practices not supported as effective by research (Brock et al., 2019; Knight et al., 2019; Kodak et al., 2018; Paynter et al., 2017) the extent of this gap has not been well studied. We surveyed 99 teachers in Ohio about their highest priority goals for students with autism spectrum disorder (ASD). There are several reasons that may explain why teachers of students with ASD do not use EBPs in their teaching. These include: a lack of knowledge about many of the EBPs (Paynter et al., 2017), a lack of training in EBPs (Hsiao & Petersen, 2019), teachers' attitudes (Locke et al., 2019), a lack of resources (Stokes et al., 2017), and a lack of administrative support (Wilson & Landa, 2019). Although these factors contribute to our knowledge about some of the barriers of implementing EBPs in Western contexts, questions arise about the implementation of EBPs in the Saudi context, whether Saudi special education teachers use specific practices, what consideration they take when they make decisions about their practice, and if they have knowledge about EBPs.

The policy reform in the USA, such as the NCLB Act of 2001 and the Individual with Disabilities Education Improvement Act of 2004 meant that USA teachers not only had to identify these practices but implement them too. With respect to the identification of EBPs, Marder and deBettencourt (2015) asserted that it is important for teachers to have a clear understanding of what EBPs are likely help them in making decisions if the disparity between research and practice is to be reduced. Therefore, teachers must have a clear understanding of what an EPB is, what EPBs exist for them to use in teaching students with ASD, and which EBPs are relevant to their students' needs.

Thus, a central question can be posed which relates to these concerns and has been addressed in this research. This question has been: How do teachers understand the concept of EBPs? little attention has been paid to this issue in the special education field and most of the studies related to evidence-based practices for students with disability have been conducted in Western contexts. In the context of KSA, there has only been one study that has examined teachers' knowledge and use of several (listed) EBPs in relation to students with disability. In the KSA, Alhossein (2016) undertook a survey study of teachers' knowledge of EPBs associated with the teaching of special education students with emotional and behavioural disorders. Some other studies focused either on teachers' knowledge of ASD and its related teaching practices (Alnemary, 2017), or on investigating the level of knowledge and the use of one specific practice such as Applied Behavioural Analysis (ABA) (Alotaibi, 2015), or social stories (Alotaibi et al., 2016). No KSA studies addressed teachers' understanding of the concept of EBPs.

An understanding of the applicability and relevance of evidence, evidence-based, and EBPs will differ depending on the context (e.g., the location and type of education being provided, as well as how an education system functions) (Foster, 2014). The Kingdom of Saudi Arabia, as with other countries, has its own culture that encompasses multiple forms of knowledge, beliefs and values, its religion, the social systems, and its own education system. For example, the Saudi education system (i.e., its policies and objectives) is informed by Islamic beliefs and dogmas, and consists of gender segregated schools (Marghalani, 2017). It can be considered to be a state-sponsored enterprise and is highly centralised (Marghalani, 2017). As a result of these

influences on the education system Saudi teachers will have particular and unique explanations for how and why they understand and/or experience evidence in education and Evidence Based Practices. These explanations may be quite different from those expressed in other contexts and countries. In this context, this study is important in that it explores Saudi special education teachers' explanations of evidence, evidence-based, and EBP from a unique cultural context.

Research Methodology

Research Design and Approach

This study explored special education teachers' perceptions of evidence, evidence-based, and Evidence Based Practices (EBPs) in the KSA context. It considered the context of the teachers' teaching practices by examining the particular phenomenon of EBPs as practised and understood by teachers in a centre teaching students with ASD in the KSA. A single case study was therefore used to explore this phenomenon within its natural context i.e., the Centre (Yin, 2018). In addressing the research question, qualitative approach was used. This approach can help a researcher to understand the ways people "construct their world, and what meaning they attribute to their experiences" (Merriam & Tisdell, 2016, p. 6). In this study, the research question was exploratory in nature focused on how these teachers constructed their own meanings of the concepts: evidence, evidence-based, and EBPs during the school year 2017-2018.

Study Site and Participants

This study was conducted in the Noor Centre (pseudonym) situated in one of the mega-cities in the KSA. The Noor Centre, as stated in their official website and prospectus, provides educational programmes and services to support and develop the abilities of students with ASD to enable them to achieve independence and to integrate within their communities. This Centre includes practitioners from different disciplines including psychologists, sociologists, academic advisors, and special education teachers for children with ASD. Students who attend this Centre are boys and girls from 3 to 15 years old. External experts/Academics from different universities in the KSA train the Centre staff. Those External experts/Academics also provide counselling support and guidance to parents and families of students with ASD. The Centre staff also prepare educational professionals to become specialists in the field of autism. Given these characteristics, this site provided an appropriate setting to investigate special education teachers' teaching practices and their perceptions and use of evidence, evidence-based, and EBPs in the context of the KSA.

In qualitative research, the aim is to develop an in-depth understanding of the phenomenon under study and, therefore, the number of participants is often small (Cohen et al., 2017; Seidman, 2019). Cohen et al. (2017, p. 144) have argued that "the correct sample size depends on the purpose of the study and the nature of the population". Purposive sampling was chosen to select the participants for this study. A purposive sample is a non-probability sample that is selected based on the characteristics of the population and appropriate to the objective of the study (Cohen et al., 2017). The main reason for choosing this sampling type was to explore a specific population (that is, special education teachers and their practices) in greater depth (Palinkas et al., 2015). In addition, the use of purposive sampling in this study was informed by the study's research question. The research question was framed around exploring the special education teachers' understanding of the concepts: evidence, evidence-based, and EBP.

The study purposively selected six teachers who had varying amounts of teaching experience and were called Principal Teachers who were primarily responsible for teaching the students facilitating student learning in their classrooms at the Noor Centre. At the Noor Centre,

teachers who had less than two years' experience were trainees and did not take on a full teaching role, but rather monitored the teaching-learning process in the classroom and undertook minor teaching-type duties. The participants were all female special education teachers as recruitment and employment in the education system in the KSA is single sex. The demographic information about the special education teacher participants has been provided in Table 1.

Table 1
Demographic Information about the Teacher Participants

Participants (pseudonyms)	Qualifications	Experience
1. Farah	BA Psychology	13 years
2. Dana	BA Special Education	11 years
3. Samar	BA History	9 years
4. Heba	BA Psychology	6 years
5. Lama	BA Sociology	4 years
6. Aseel	BA Special Education	3 years

Data Collection Instrument

As a method of data collection in this study, an interview was adopted. According to Merriam and Tisdell (2016), interviews are used mainly to identify how people interpret, understand and make meaning of the world around them. Moreover, interviews may allow interviewees to give their answers on their own terms and at their own pace (Cohen et al., 2017).

In this study, individual semi-structured interviews were used. The semi-structured interview is a type of interview that makes use of predetermined questions meant for all participants. However, the participants have the flexibility and freedom to express their own thoughts, opinions and feelings (Merriam & Tisdell, 2016; Patton, 2015). This type of interview also creates an opportunity for the researcher to modify the sequence of the questions depending on the interviewee's responses (Cohen et al., 2017). In addition, it allows the researcher to ask off-script, supplementary questions in order to generate more details in case of the emergence of important new issues during the interview (Seidman, 2019). The questions for the semi-structured interview were open-ended, they comprised a predetermined set of questions about the participants' experience of selecting teaching practices, the kind of evidence the participants relied on, and what the concepts of evidence, evidence-based, and EBPs meant to them. Prior conducting the interviews with the participants in the main study, a pilot study was carried out with two teachers in order to correct any error and unclear questions.

The interview guide included twenty-eight questions distributed across four sections (See Appendix). The four sections represented four topics designed to obtain responses to Research Question. These were (1) the participants' backgrounds, (2) the participants' perceptions of the goal of teaching students with ASD, (3) the participants' experiences in selecting their teaching practices in lessons, and (4) their understanding of the terms evidence, evidence-based, and EBP. The sequence of questions and how the questions were posed were kept flexible and were based on the participants' responses in the interview (Merriam & Tisdell, 2016). The teachers' responses were often elaborate, and, in their responses, they often answered questions that

would come up elsewhere in the interview. I followed their conversational way of answering (Brinkmann, 2013), while making sure that all the questions were covered by the end of the interview by marking off the questions as they were answered.

Data Analysis

In analysing the interview data, a thematic analysis framework of Braun et al. was utilized. The data were coded, then grouped into categories according to teachers' knowledge and understanding of evidence, evidence-based, and EBPs. These were organised diagrammatically in concept maps, then the themes were refined and reported as the study's findings.

Research Results

Teachers' Knowledge and Understanding of Evidence

Five teachers understood evidence as their experience, or someone's experience, or both. Lama viewed evidence as her own experience, defining evidence as "any strategy that I had tried and had positive outcomes". Similar to Lama, Samar also considered her experience as a form of evidence. She further argued that "Trial and error is the best method in determining effectiveness because theorising is not useful".

Heba added that the source of evidence was not her top priority as long as the practice worked successfully with the student. She argued, "I do not care where the source [comes] from, what I do care about is to what extent this practice is successful with the child". Heba implied that teachers would try any strategy that helped to overcome the difficulties regardless of the source of evidence.

Aseel and Farah considered their individual experiences and also other teachers' experiences as evidence. Aseel put emphasis on not using a practice that "has not been tried" by other teachers. In the same way, Farah also understood evidence as the strategy that "I tried it, or someone tried it, [and] found [it] to be effective".

From a different perspective, Dana understood evidence in many different ways. She viewed evidence as a combination of research-based knowledge and individual experiences. She stated that evidence is both "empirical research, and something which I practically tried, and it was effective. Both are evidence". Dana did not prefer one source over the other, instead, she believed that the research supplemented her experience.

Dana also pointed to the importance of parents' opinions in understanding and using evidence as effective or ineffective. She considered positive feedback from the family about the methods and techniques that she tried out as evidence of effectiveness. She gave an example of how a father approved of her methods when he observed the positive results with his child saying

"... The father of the child confirmed that his son knew the pictures from the first time, but he has never seen him doing such things practically [like the child does now]. I was asked about these methods that I implemented and about the resources I used. I told him that I developed these methods to allow more practical and meaningful implementations. (Dana)

All of the teachers had argued that their teaching experiences were evidence. The experiences of Senior Teachers and colleagues were also important in their understanding of evidence. The opinions of parents and research-based practices in combination were also understood as evidence by one teacher.

Teachers' Knowledge and Understanding of Evidence-Based

Teachers' knowledge and understanding of evidence-based was equated to the advice of their superiors. When the participant teachers of the Noor Centre were asked about their understanding of evidence-based, the majority of the teachers referred to advice given by their superiors as being evidence-based. Those superiors were the Advisors, the Psychologist, and the External Experts/Academics. Data from the teachers' responses revealed that the teachers, in most cases, referred to the Advisors for information about educational methods and techniques and pedagogy, the Psychologist for ways of solving problem behaviour, and the External Experts/Academics for both educational and behavioural advice.

Lama stated "Academics and Advisors are my evidence-base. I always report back to them and ask for instructions".

Similarly to Lama, but referring to the Centre policy, Samar stated:

Evidence-base is my Advisor; this is the policy here. We are required to consult the Advisors and take the advice from them. Or the Academic when he attends the Centre". (Samar)

Aseel stated "I always refer to people here, the Advisors, the Academic, they are my evidence-base". Regarding solving problem behaviour, Aseel added "Firstly, I ask the Psychologist here. If we could not find a solution; I would then ask the Academic and explain the problem".

Along the same lines, Farah added an emphasis on the consultations with the Psychologist in solving the students' behavioural problems. She also indicated that "always my reference is my Advisor; we are not used to saying this method is good or this is bad". Farah claimed that the teachers in the Centre did not have the habit of judging what was effective or not since the policy of the Centre required the teachers to call on the Advisor as a point of reference. This indicates the strong influence of the Centre's culture on the teachers.

Heba supported Farah's argument in relation to viewing evidence-based as their superiors' advice. Likewise, she referred to the Centre policy stating: "It is an obligation here. If there were any problems or goals were not achieved, the Advisor and the Psychologist are to be advised. Otherwise, I will be held accountable".

Unlike other participant teachers, Dana understood evidence-based differently. She viewed evidence-based as being research-based. She contended "it means ... to have an understanding that particular evidence comes from research". Dana explained that her understanding of evidence 'as research' originated from the repeated asking for researched sources by her former Advisor, particularly at the beginning of her job. She explained

... I worked with an Advisor who was very systematic and asked for evidence of everything I put forward or said. So, it has become a grounded base in my work ... It became a habit to always back up and support my information with [scientific] evidence. (Dana)

This finding related to Dana provides strong evidence of the influence of the context on teachers' understanding of evidence-based and how the context shaped the teacher's understanding of the meaning of evidence-based. In this study, Dana was the only teacher whose understanding of evidence-based as a research-based practice aligned with what was suggested in the literature. This indicated the important role of these teachers' workplace and the kinds of mentoring they received in their workplace in promoting an evidence-based identity.

Teachers' Knowledge and Understanding of Evidence Based Practices

The analysis revealed that teachers understood Evidence Based Practices (EBPs) as the “list” or group of practices that was mandated for use by the Centre that were recognised in the field of autism and drawn from a range of sources they said:

It is “a group of teaching methods based on international programmes, just like the practices given here” (Heba).

Farah understood it as “a list of many practices that were found to be effective by many autism programmes. Some of these practices are implemented here”.

Similarly, Aseel indicated that there were “some programmes backing up them [practices], like practices that are provided here”.

While Dana said:

EBPs are a group of teaching practices that have been recognised by many reliable programmes in the autism field. Indeed, a lot of these practices are given by the Centre. (Dana)

These teachers' understanding of EBPs as a given list of programmes and practices reinforces the idea that EBPs were understood as a ‘prescription’ or ‘manual of instructional techniques’ that was adopted by the Centre and that the teachers were required to implement the programme and associated practices.

Discussion

In this chapter, the analysis revealed that almost all teachers understood evidence as their own individual, or other teachers' experiences. They also suggested that when the results of a strategy were retained over time, the effectiveness of any strategy could be determined through trial and error. One teacher understood evidence as a combination of her experience and research, and whether she received the approval of parents who indicated that in their view the strategy was effective. In this regard, it can be contended that the teachers' understanding of evidence came in the forms of experiential evidence and contextual evidence. This finding indicates that the understanding of evidence as information derived from research (Cook, 2015; Mesibov & Shea, 2011) was not a dominant understanding among the teachers.

Previous research examining teachers' understanding of the concept of evidence in special education has been limited. Only one study was found that examined special education teachers' perceptions of evidence (i.e., Greenway et al., 2013). Most of the special education teachers of students with intellectual and developmental disabilities in that study perceived evidence as their personal experience and knowledge, and as information from multiple sources (student-work and parents). This current study adds to the growing body of research on EBPs by revealing how special education teachers of students with ASD understand evidence in the context of KSA.

Teachers' understanding of evidence-based comprised the advice and consultations from their superiors within the Centre. Only one teacher had a more nuanced way of understanding evidence-based, defining this idea in relation to the idea of practices being research-based. According to these findings, the teachers' understanding of evidence-based was shaped by the hierarchical power structure of the Centre. Since the policy of the Centre required teachers to call on their superiors as a point of reference about their teaching practice, it is likely that teachers' understanding was constructed based on the culture of the Centre. The findings in this section add a new understanding of how these teachers of students with ASD understood the concept of evidence-based. Studies were found in the special education field that examined teachers' views (Boardman et al., 2005) or perceptions of research-based evidence (Hudson et al., 2016).

These earlier studies assumed that teachers already had an understanding of evidence-based as research-based. This current study appears to be the first study to explore the teachers' understanding of the concept of evidence-based among teachers of students with ASD and has found that these teachers did not have this same underpinning understanding.

Lists of EBPs have been identified and published by many professional organisations. These lists are meant to be a resource that helps teachers in their decision-making process with respect to determining the teaching programmes and practices they should use (Spencer et al., 2012; Cook & Cook, 2016). In this study, the majority of teachers defined EBPs as a list or a group of programmes and practices given to them by their superiors in the Noor Centre to implement. Their understanding of EBPs as a given list reinforces the idea that these teachers understood EBPs to be technical tools, rather than understanding them to be resources that help them in the decision-making process associated with the selection of teaching practices. This finding differs from Denniston's (2017) study in which 12 primary school special education teachers of students with ASD in a USA study were surveyed. The study found that the majority of the teachers defined EBPs as research practices that "supported" or "assisted" students with ASD and as practices that were "effective" or had "positive results (benefit)" (p.125). However, the findings of this current study are consistent with those of Hudson et.al. (2016) who interviewed special education teachers of students with emotional and behavioural disabilities in four school districts in the USA and revealed that these teachers "defined EBP in ways that externalised the locus of authority for what constituted relevant evidence for practice as the results of 'studies someone had done'" (p.34). The researchers argued that "ironically, this view also appeared to be the focus of considerable tension and concern, as many of the practitioners we interviewed expressed the idea that research did not adequately reflect the characteristics of the students they served nor the contexts of the decisions about practice they were charged with making on a daily basis" (Hudson et al., 2016, p. 34). The latter view was also expressed by the majority of the teachers in this current study.

Also, the findings of the current study revealed that these teachers had limited knowledge of contemporary understanding of EBPs as suggested in the literature and as defined as a situated decision-making process that integrates the best available research with the professional judgement of the teacher and the client's (learners and their families) values and context (see for example, Cook & Cook, 2016; Spencer et al., 2012). In this study, the teachers gave weight to the programmes and practices that the teachers were required to implement by the Centre and the Centre's policies and teaching guidelines and diminished or negated other elements in their understanding of EBPs. Thus, their understanding of EBPs was formed primarily by the context. Such an influence is also likely to affect the way these practices were implemented (Alhossein, 2016).

Conclusions and Implications

The aim of this study was to investigate a small group of special education teachers' perceptions of evidence, evidence-based and Evidence Based Practices (EBPs) in the context of one autism centre in the Kingdom of Saudi Arabia (KSA). The findings of the analysis of the interviews revealed that the teachers' knowledge and understanding of evidence, evidence-based, and EBPs was shaped by the hierarchical order of the Centre. These teachers referred to their own individual experiences or the experiences of other teachers as evidence. In addition, they referred to their superiors' advice as being evidence-based and the perceived EBPs as technical tools handed to them by the Centre. This means that how teachers think, believe, and act were shaped by the contextual factor i.e., the culture of the Centre (hierarchical organisational structure).

This study suggests several opportunities for future research. Further investigation could involve quantitative methods with a larger sample size and different settings to explore whether teachers' perceptions of the concepts of evidence, evidence-based, and EBPs will yield similar results. Furthermore, it would be interesting to explore the experience of male special education teachers and to identify if different factors contribute to their knowledge and understanding of EBPs.

The findings of this study suggest several courses of action for policymakers and teacher education. Firstly, as this study revealed teachers' limited knowledge and understanding of evidence, evidence-based, and EBPs, there is a need to increase teachers' knowledge and encourage them to be research-informed. Therefore, teacher education, both pre-service and continuing professional learning, needs to design or develop courses that specifically address these topics.

Limitations

This study adopted a case study approach to explore the teachers' perceptions of the concepts of evidence, evidence-based, and EBPs in one autism centre in the KSA. Hence, the findings of this study might not be generalisable to other autism centres or other disability centres in the KSA. In conducting a case study, generalisation is not the aim. It seeks to provide a deep understanding of the phenomena under the study rather than seeking generalisation to other contexts. Generalisability would be enhanced by expanding the study to include different kinds of centres from different cities. This expansion would provide a wider range of perspectives which would enrich the knowledge about the teachers' perceptions regarding evidence, evidence-based, and EBPs. Even so, the findings complement and extend other research in the field, as indicated in this earlier, adding weight to the body of evidence.

Declaration of Interest

The authors declare no competing interest.

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Appendix: Semi-structured Interview Protocol Special Education Teachers of students with ASD

Date Interviewee (pseudonym).....

Start time..... End time

Greet the interviewee.

State the purpose of the interview: I would like to know about your experience of teaching practices, the kind of evidence you rely on and what does evidence mean to you.

A. Background questions

First, I want to ask you some background questions.

1. How long have you been teaching in general?
2. How long have you been teaching students with ASD?
3. Where did you do your preservice teacher training?
4. What is your highest teaching qualification? When did you obtain that?
5. What qualifications do you have specifically related to teaching students with ASD?
6. What class(es) do you teach at this Centre?
7. How would you introduce yourself as a teacher?

B. The next question is about your goal as a teacher with respect to your students and their learning. I want to ask you about your goal.

8. What is your general goal in teaching students with ASD?

C. The rest of the questions relate to your understanding of the terms “evidence”, “evidence-based”, and EBP.

9. a. What does the word “evidence” mean to you? b. In what context would you use it? c. How do you use this term in your teaching?
10. a. What does “evidence-based” mean to you? b. In what context would you use the word “evidence-based”?
11. a. What does “evidence-based practice” mean to you? b. In what context would you use the word “evidence- based practice”?
12. a. When you are using a practice with students or sharing a teaching practice with a colleague, how do you know if the teaching practice is evidence-based?
13. a. What types of evidence do you use? b. What types of evidence do you mostly rely on?
14. a. To what extent do you think evidence is relevant to your classroom decision-making and classroom practice? b. Why? c. Please provide an example.
15. a. Please identify a situation or circumstance that made you look for an evidence-based practice.
16. Which sources of information about evidence-based practices do you find most useful?
17. How do you usually realise that a current classroom teaching practice needs to be changed or replaced by some other practice? b. Please describe such example.
18. a. Describe a time when you implemented practices or instructional strategies from research based on evidence. b. How long did you use that practice or instructional strategy?

19. Are there any of challenges when you implement a new practice?
20. How does the *Noor Centre*'s policies and practices around teaching students with ASD affect your efforts to implement evidence-based practices? b. Can you give me an example?
21. What role does your Principal play in deciding what teaching practices you use in your lessons in the classroom?
22. What kind of support would be most helpful in using evidence-based practices?
23. How would you describe your role in deciding what teaching practices to use? Describe a typical process of selecting a practice?

D. Closing question

24. Is there anything else that you would like to tell me about evidence and EBP in teaching students with ASD.

Thanks

Thank you for participating in this Interview.

Probes/ Follow up questions

1. What do you mean by X?
2. Can you provide an example of X?
3. Can you explain that a little bit more?
4. Please describe X.
5. How did/does X influence your [practice]
6. In your opinion, [. . .?]
7. Why do you think [X is ...]?

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UPPER-SECONDARY SCHOOL STUDENTS' CEREBRAL DOMINANCE AND LEARNING STYLES: THE MEDIATION OF CHRONOTYPES

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Abstract

Learning styles, cerebral dominance and chronotypes are among the factors that have been determined to be effective on individuals' learning. It is stated in the literature that these three variables are interrelated or affect each other. Therefore, the aim of the study is to determine the extent to which students' cerebral dominance predicts their learning styles and whether chronotypes have an effect on this level of prediction as a moderating variable. In the research, the "Morningness-Eveningness Stability Scale improved" (MESSI), the "Kolb Learning Style Inventory" (KLSI) and the "Hermann Brain Dominance Instrument" (HBDI) were used as data collection tools. The selection of upper-secondary schools included in the sample was made in a district of Antalya province with the convenience sampling method. The sample of 593 students who agreed to respond to the scale was formed from 9th, 10th, 11th, and 12th grade students studying at these upper-secondary schools in the 2021-2022 academic year. According to the analysis results of the structural equation model (SEM) obtained in the study, it was concluded that there were significant positive correlations between learning styles and the sub-dimensions of cerebral dominance; however, chronotypes did not significantly mediate the determined correlations. The findings of this study may provide implications for determining learning styles, which have proven effects on student performance in the teaching-learning process, and, by establishing relationships between individuals' brain structures and chronotypes, the characteristics that direct learning preferences.

Keywords: cerebral dominance, chronotypes, learning styles, structural equation model, upper-secondary school

Introduction

Studies in the field of education emphasise that individual differences of students should be taken into account in the teaching-learning process. As a matter of fact, the individual differences of students significantly affect the quality of learning. The first difference that comes to mind when it comes to individual difference in education is intelligence, but it is undeniable that many individual factors have an effect on learning. One of the factors affecting learning is the learning style of the individual (Dikmen et al., 2018). Learning style is concerned with how the individual learns rather than how much he learns and is defined as "the methods preferred by the individual in the process of receiving and processing information" (Jonassen & Grabowski, 2012). In Kolb's learning style inventory, students are classified in terms of learning styles according to their preferences for how they comprehend knowledge and how they internalise knowledge (Felder, 1996; Kolb & Kolb, 2005a). In the teaching-learning process, too, the teaching methods preferred according to students' learning styles, which reflect their learning preferences, enable students to perform better (Felder, 1993). In order to facilitate individuals' learning and to increase their awareness of their learning preferences,

it can be seen that in the field of educational sciences, brain-based studies have mostly been associated with learning (D'Amato & Wang, 2015). According to Ned Herrmann's whole brain model, in which the brain is expressed in four quadrants according to the relationship between the right and left hemispheres, it has been reported that the brain is associated with learning (Herrmann, 1996). Both hemispheres interact with each other under normal conditions and each individual's brain structure consists of a different perception and learning system. Therefore, defining how the brain learns facilitates people's learning and makes understanding long-term and powerful (Arıcan & Polat 2020). Just as individuals' brain structures form different learning characteristics, their biological activities can also be effective on their learning. In fact, chronotypes, which are defined as the tendencies of individuals to prefer working/learning at different times of the day, also have an effect on learning (Horne & Ostberg, 1976). Individuals' chronotypes gradually deteriorate with advancing age (Pıçak et al., 2010). While morning types are common in primary school children, their tendency to become evening types increases with children's transition to puberty (Arbabi et al., 2015). In particular, irregular sleep habits in individuals can lead to negative consequences for their learning outcomes (Škvorc & Bjelajac, 2016).

Literature Review

Kolb's Learning Styles

There are different approaches to learning styles: the Kolb Learning Style Model (Kolb, 1984), Witkin's Learning Styles (Witkin, 1964), the Canfield Learning Style Model (Canfield, 1988), Silver, Hanson and Strong's Learning Style Model (Silver et al., 1979), the Gregorc Learning Style Model (Gregorc, 1979), the Butler Learning Style Model (Butler, 1987), and the Dunn and Dunn Learning Style Model (Dunn & Dunn, 1979). Kolb's Learning Style Model is divided into four basic categories, namely "Concrete Experience, learning by feeling", "Reflective Observation, learning by observing", "Abstract Conceptualisation, learning by thinking", and "Active Experimentation, learning by doing" (Kolb, 1984). According to Kolb (1984), individuals may prefer different ways of learning, or use the different ways of learning together. The dimensions of "concrete experience" and "abstract conceptualisation" reveal the environment in which people live and their perception preferences. In Kolb's model, abstract conceptualisation and concrete experience constitute the "perception" dimension.

Perception encompasses the individual's learning with emotional attitudes from concrete experiences, or developing symbolic contexts from experiences. "Reflective observation" and "active experimentation" explain the "transformation" dimension that reveals individuals' ability to blend and process information (Gencel, 2007; Jonassen & Grabowski, 2012; Kolb, 1984). Kolb arranged the perception and transformation dimensions into four quadrants. He specified each of these quadrants as a learning style. Each quadrant specified in Kolb's learning styles does not present the individual's dominant learning style by itself. Rather, everyone's learning style is defined as "a combination of the four quadrants" and the combined scores obtained from the quadrants in the model find out the individual's preferences, ranging "from abstract to concrete and from active to reflective" (Kolb & Kolb, 2005a). In the teaching-learning process, teachers' planning of the process by considering the students' learning styles supports students' high learning performance (Felder, 1993).

Cerebral Dominance

Modern neuroanatomy divides each hemisphere of the brain into four basic lobes, which are named as follows: frontal (just behind the forehead, the anterior part of the brain), parietal (at

the top, the part of the brain towards the rear), temporal (at the sides, the part of the brain below the temples) and occipital (the most posterior part of the brain) (Ganis et al., 2007). Herrmann's model emerged as a product of studies conducted by evaluating EEG (electroencephalography) data, and from these studies, a model was created that reveals the structure of the human brain. According to the "four-quadrant model of the brain" that was created, the brain's right and left hemispheres are responsible for different functions (Solso et al., 2007). The left hemisphere is "analytical, abstract, verbal, digital, logical, sequential and rational", the right hemisphere is "holistic, concrete, non-verbal, visuospatial, intuitive, simultaneous and analogical" (McCarthy et al., 2006). In the whole brain model, when the hemispheres of the cerebral and limbic system are included, the brain is characterised as four quadrants (Herrmann, 1995). The quadrant which is used dominantly while learning affects individuals' learning preferences. Individuals may choose to use one quadrant or several quadrants while learning new information (Herrmann, 1996). Although each hemisphere has different functions, the brain carries out its functions holistically. For efficient learning, both hemispheres of the brain should be involved in learning activities during learning (Senemoğlu, 2004).

Chronotypes

People show different chronotype characteristics, namely morningness, eveningness and distinctness (intermediate-type), due to differences in biological and behavioural patterns such as the sleep-wake cycle and body temperature (Adan et al., 2012). Chronotypes, which reveal at what time of the day an individual is more prone to learning, are divided into three categories (Horne & Ostberg 1976): These are "morning types, who prefer to go to bed early at night and get up early in the morning", "evening types, who prefer to go to bed late at night and wake up late in the morning", and intermediate types, who exhibit the characteristics of these two types together. Morning types' performance is at the highest level during the morning. Evening types, stay up late at night and wake up late, and their performance is at the highest level at night times (Selvi et al., 2010). Individuals for whom the time period in which they perform at the highest level differs in this cycle, without a clear distinction, constitute the intermediate type. People with various chronotypes differ not only in sleep or wake times, but also in cognitive characteristics. It has been stated in the literature that chronotypes have an effect on individuals' learning, especially with regard to sleep patterns (Škvorc & Bjelajac, 2016).

Relationships between the Variables

While explaining concrete experience, which is the first stage of the learning cycle, Kolb (1984) emphasised that emotions and feelings come to the fore in learning. In this respect, it is directly similar to the characteristic of emotionality which is fostered in the individual by the emotional sub-dimension of cerebral dominance (Du Toit, 2018). In reflective observation, which is the second stage, emphasis is placed on the detailed, planned, organised, and orderly (sequential thinking) characteristics of the individual that are emphasised in the safekeeping sub-dimension of cerebral dominance, such as questioning facts, developing different perspectives, and trying to understand the thinking underlying events and phenomena (Herrmann, 1996; Kolb, 1984). In abstract conceptualisation, on the other hand, the characteristics of the individual have intellectual cerebral dominance, which are described as logical, intellectual, analytical, and reality-based, are parallel with the characteristics of the individual that focus on logic and thought rather than on emotions (Du Toit, 2018). In active experimentation, which is the final stage of the learning cycle, the emphasis is on individuals who learn based on their experiences and practices (Kolb, 1984). Therefore, it shows similarity with the experiential, synthesising and integrative characteristics of the individual specified in the experimental sub-

dimension of cerebral dominance (Herrmann, 1996). In the current study, hypotheses regarding the correlations between the variables have been formed based on the similarities explained above between the sub-dimensions of cerebral dominance and learning styles. In addition, as stated in the previous sections, based on the view that the effects of cerebral dominance and learning styles, chronotypes are also effective on individuals' learning, and since chronotypes are associated with both cerebral dominance and learning styles, this suggests that chronotypes may have a mediating effect in the correlations established between cerebral dominance and learning styles. In order to test these predicted correlations, hypotheses based on the mediating effect have been formed.

Research Problem

There are studies in the literature that have extensively compared chronotype with various demographic variables (Adan & Natale, 2002; Kim et al., 2002; Natale & Danesi, 2002; Randler, 2007; Randler & Engelke, 2019). In addition to these demographic variables, there are few studies examining the relationships between chronotype and learning styles in undergraduate students (Balci & Çalışkan, 2022; Davidson & Ritchie, 2006). There are also studies in the literature examining learning styles and brain dominance together (Ali & Kor, 2007; Kırkgöz & Doğanay, 2003; Özgen et al., 2011). As a result of the literature review, no research has been found that examines the relationships between upper-secondary school students' brain dominance, chronotypes and learning styles.

In many countries such as Turkey, the learning of individuals aged 15-18, whose future depends on their success in certain exams, gains more importance compared to other age groups. In this respect, it is considered substantial to investigate the effects of learning style and brain dominance variables, which have been determined to have an effect on learning, on these individuals who emerge from childhood and are referred to as young people and adolescents. Revealing whether the dominant brain regions of young people have a connection with their dominant learning styles may contribute to the literature in terms of investigating the different characteristics of individuals in the learning process. Also, it can be said that the relationship of chronotypes between brain dominance and learning styles may play a significant role, by predicting that the sleep patterns that determine the chronotypes of young people may also change in this age group compared to their childhood.

The study emphasizes that the individual differences of students should be taken into account in the organization of educational activities in the teaching-learning process, and program development. It is important for individuals to be aware of the time in which their mental performance is highest, especially when organizing individual learning activities. Also, it is significant to have self-awareness that can shape their own learning processes in terms of the specified variables, with the awareness that there is a connection between their brain dominance and their preferred learning styles. In the same way, it is useful for an educator to be aware of the need to know the students in terms of the specified variables, in order to organize teaching-learning activities on the basis of students and to raise students' self-awareness. In addition, it can be said that the study will contribute to future research that aims to study individual differences in learning.

This study aims to determine the extent to which students' cerebral dominance predicts their learning styles and whether chronotypes have an effect on this level of prediction as a moderating variable. The hypotheses formed in line with the purpose of the study are given below:

The Hypotheses Regarding the Correlations between the Variables

- H1. "The Intellectual sub-dimension" is positively correlated with "Abstract Conceptualisation".
- H2. "The Safekeeping sub-dimension" is positively correlated with "Reflective Observation".
- H3. "The Emotional sub-dimension" is positively correlated with "Concrete Experience".
- H4. "The Experimental sub-dimension" is positively correlated with "Active Experimentation".
- H5. The "Intellectual" (H5a), "Safekeeping" (H5b), "Emotional" (H5c) and "Experimental" (H5d) sub-dimensions are positively correlated with Morningness.
- H6. "Morningness" is positively correlated with "Concrete Experience" (H6a), "Reflective Observation" (H6b), "Abstract Conceptualisation" (H6c) and "Active Experimentation" (H6d).
- H7. The "Intellectual" (H7a), "Safekeeping" (H7b), "Emotional" (H7c) and "Experimental" (H7d) sub-dimensions are positively correlated with "Eveningness".
- H8. "Eveningness" is positively correlated with "Concrete Experience" (H8a), "Reflective Observation" (H8b), "Abstract Conceptualisation" (H8c) and "Active Experimentation" (H8d).
- H9. "The Intellectual" (H9a), "Safekeeping" (H9b), "Emotional" (H9c) and "Experimental" (H9d) sub-dimensions are positively correlated with Distinctness.
- H10. "Distinctness" is positively correlated with "Concrete Experience" (H10a), "Reflective Observation" (H10b), "Abstract Conceptualisation" (H10c) and "Active Experimentation" (H10d).

The Hypotheses Involving the Mediating Variables

- H11. "Morningness" (H11a), "Eveningness" (H11b), and "Distinctness" (H11c) mediate the effect of the "Intellectual" sub-dimension on "Abstract Conceptualisation".
- H12. "Morningness" (H12a), "Eveningness" (H12b), and "Distinctness" (H12c) mediate the effect of the "Safekeeping" sub-dimension on "Reflective Observation".
- H13. "Morningness" (H13a), "Eveningness" (H13b), and "Distinctness" (H13c) mediate the effect of the "Emotional" sub-dimension on "Concrete Experience".
- H14. "Morningness" (H14a), "Eveningness" (H14b), and "Distinctness" (H14c) mediate the effect of the "Experimental" sub-dimension on "Active Experimentation".

Research Methodology

Research Design

The study is based on a correlational research model. Examination of the correlations between variables constitutes the correlational survey model (Karasar, 2011). The research data were collected from upper-secondary school students studying in state upper-secondary schools in a district of Antalya province in Turkey, during the 2020-2021 academic year, by obtaining the necessary permission from the "Directorate of National Education". Also, ethics committee approval for the research was obtained from the "Social and Human Scientific Ethics Committee of Akdeniz University" (Date: August 31, 2021; Code: 159919, Ethics Committee Decision Number: 301). During the data collection process, the scales were administered to the students online due to the COVID-19 pandemic.

Study Group

The accessible population of the research was determined as upper-secondary schools in the province of Antalya in Turkey. The selection of upper-secondary schools included in the sample was made in a district of Antalya province with the convenience sampling method. The

sample of 593 students who agreed to respond to the scale was formed from 9th, 10th, 11th, and 12th grade students studying at these upper-secondary schools in the 2021-2022 academic year. In structural equation modelling, the ideal sample size has been specified as 20 times the number of parameters to be estimated in the model, and 10 times as a less ideal number (Kline, 2011a). The number of samples in the study is 50 times the number of parameters (11). Among the individuals in the study group, 325 (53.9%) were female and 268 (46.1%) were male. The upper-secondary schools where the participants studied were Anatolian schools (131 people, 21.7%), science schools (158 people, 26.2%), Imam Hatip schools (54, 9.0%), vocational schools (158 people, 26.2%) and medical vocational schools (101 people, 16.7%). Among the participants in the study group, 195 (32.3%) were in the 9th grade, 186 (30.8%) were in the 10th grade, 106 (17.6%) were in the 11th grade, and 116 (17.6%) were in the 12th grade.

Data Collection Tools

In the research, the “Morningness-Eveningness Stability Scale improved” (MESSI), the “Kolb Learning Style Inventory” (KLSI) and the “Hermann Brain Dominance Instrument” (HBDI) were used as data collection tools.

Morningness - Eveningness Stability Scale Improved (MESSI)

Developed by Öğütlü et al., (2021), this scale is used to determine morning and evening types. The scale consists of 15 items and three sub-dimensions. These sub-dimensions are “morningness”, “eveningness” and “distinctness”. The ways of responding to the Likert scale are in the form of 1-“it is definitely not easy” to 5-“it is extremely easy” in the first item, 1-“I do not feel awake at all” to 5-“I feel very awake” in the second item, 1-“between 0-10 minutes” to “between 5-60 minutes” in the third item, 1-“very low” to 5-“very high” in the fourth and fifth items, and 1-“completely inappropriate” to 5-“completely appropriate” in the other items. The first, second, third, fourth and sixth items of the scale constitute the morningness dimension. The fifth, seventh, thirteenth, fourteenth, and fifteenth items comprise the distinctness (intermediate type) dimension; the eighth, ninth, tenth, eleventh, and twelfth items form the eveningness dimension. The Cronbach alpha coefficients were calculated as .69 for morningness, .76 for distinctness and .40 for eveningness. Values of ($\chi^2 = 2003.85 / df = 404 = 4.95$ ($p = .00$), GFI = .78, IFI = .87, CFI = .87, NFI = .85, AGFI = .75, RMSEA = .09, RMR = .50, and SRMR = .07 were obtained from the confirmatory factor analysis.

Confirmatory factor analysis for the MESSI was repeated for this study, and values of ($\chi^2 = 93.36 / df = 32 = 2.93$ ($p = .00$), GFI = .97, IFI = .97, CFI = .97, NFI = .95, AGFI = .95, RMSEA = .05, RMR = .23, and SRMR = .04 were obtained. When the obtained values are examined, the fit indices of the model are at an acceptable level (Marsh et al., 1988). The t-values obtained from the model also confirm the significance of the factor loadings. In addition, the Cronbach alpha internal consistency coefficients were also calculated. The Cronbach alpha values were calculated as .71 for the scale, .71 for the morningness dimension, .81 for the distinctness dimension, and .45 for the eveningness dimension. According to the obtained findings, it can be said that the measurements obtained from the scale and its sub-factors are at a reliable level (Büyükoztürk et al., 2016).

Kolb Learning Style Inventory (KLSI)

In this study, the “Kolb Learning Style Inventory” (KLSI) developed by Kolb (1999) and adapted into Turkish by Gencel (2006) was used to determine the learning styles of students. The scale consists of 12 complementary items (Gencel, 2006). Items have four options. The

number obtained by active learning and reflective thinking shows the x-axis in the coordinate system. The number obtained by the abstract comprehension and concrete experience operation is placed on the y-axis. Combined scores from the scale take a value between -36 and +36. The intersection of the x-axis and y-axis numbers explains the learning style of the individual (Gencel, 2006). As a result of the exploratory factor analysis and reliability analysis, it was determined that the scale, as in its original form, consists of four factors: "abstract conceptualisation", "active experimentation", "concrete experience" and "reflective observation". In the scale, the Cronbach alpha coefficients were .76 for the "concrete experience" factor, .71 for the "reflective observation" factor, .80 for the "abstract conceptualisation" factor, and .75 for the "active experimentation" factor (Gencel, 2006).

Confirmatory factor analysis for the KLSI was repeated for this study, and fit index values of ($\chi^2 = 2003.85 / df = 404 = 4.95$ ($p = .001$), GFI = .78, IFI = .87, CFI = .87, NFI = .85, AGFI = .75, RMSEA = .09, RMR = .50, and SRMR = .07) were obtained. The obtained values show that the fit indices of the model are at an acceptable level (Marsh et al., 1988). The t-values obtained from the model also confirm the significance of the factor loadings. In addition, the Cronbach Alpha coefficients were .69 for the overall scale, .76 for the "concrete experience" factor, .67 for the "abstract conceptualisation" factor, .76 for the "active experimentation" factor, and .71 for the "reflective observation" factor. According to the findings, it can be said that the measurements obtained from the scale and its sub-factors are at a reliable level (Büyüköztürk et al., 2016).

Herrmann Brain Dominance Instrument (HBDI)

The adapted version of Herrmann's four-quadrant "Brain Dominance Instrument (HBDI)" (Herrmann, 1995), adapted by Özden (2009), was used. The scale, which consists of 24-items, was graded as "strongly disagree (1)", "disagree (2)", "undecided (3)", "agree (4)", and "strongly agree (5)". There are six sections in the scale and each section includes four items. In the scale, the total of the first questions measures the dominance of the D (Holistic) quadrant, the total of the second questions measures the dominance of the C (Emotional) quadrant, the total of the third questions measures the dominance of the B (Sequential) quadrant, and the total of the fourth questions measures the dominance of the A (Logical) quadrant. The scores obtained from the brain dominance measurement tool are calculated by considering the highest scores obtained by students from the A, B, C and D quadrants. Moreover, the scale is grouped according to the regions of the brain. The reliability coefficient of the scale was calculated as .71. Exploratory factor analysis showed that as in its original form, the scale consisted of four factors, namely holistic, emotional, sequential, and logical. The Cronbach alpha values were calculated as .71 for the overall scale, .72 for the holistic sub-dimension, .71 for the emotional sub-dimension, .67 for the sequential sub-dimension, and .68 for the logical sub-dimension (Özden, 2003).

Confirmatory factor analysis of the brain dominance instrument was performed again for this study. The goodness-of-fit index values obtained for the scale were ($\chi^2 = 1194.55 / df = 246 = 4.85$ ($p = .001$), GFI = .83, IFI = .89, CFI = .89, NFI = .87, AGFI = .79, RMSEA = .05, RMR = .08, SRMR = .07). The factor structures were confirmed in the analyses that were made. It was reported that the model showed good fit (Jöreskog & Sörbom, 2006). The t-values obtained from the model also confirm the significance of the factor loadings. Cronbach's alpha coefficients were calculated as .86 for the overall scale, .52 for the holistic sub-dimension, .59 for the emotional sub-dimension, .73 for the sequential sub-dimension and .62 for the logical sub-dimension. According to the reliability coefficients, it can be said that the measurements obtained from the whole scale and its sub-factors are at a reliable level (Büyüköztürk et al., 2016).

Data Analysis

Structural equation modelling was used to develop a structural model that explains the effects of the upper-secondary school students' chronotype and cerebral dominance on their learning styles. In the analyses, the SPSS-23 program was used for descriptive statistics and correlation calculations, while the LISREL 8.7 program was used for structural equation modelling.

Research Results

Findings for the Hypotheses Regarding the Correlations between the Variables

In the study, the arithmetic mean (M), standard deviation (SD), and Pearson correlation coefficient (r) values of the variables were calculated, and the results are given in Table 1.

Table 1.
Pearson Correlation Coefficient Values of the Variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Concrete Experience	2.91	0.39		.342**	.558**	.547*	.373*	.401**	.443**	.437**	.087*	.081*	.161**
2. Reflective Observation	3.07	0.37		1	.429**	.415**	.340**	.330**	.209**	.265**	-.020	.166**	.071
3. Abstract Conceptualisation	3.22	0.41			1	.685**	.437**	.478**	.355**	.225**	.085*	.048	.119**
4. Active Experimentation	3.29	0.44				1	.348**	.450**	.400**	.244**	.049	.062	.176**
5. Intellectual	3.82	0.61					1	.700**	.591**	.579**	.048	.132**	.184**
6. Safekeeping	3.72	0.70						1	.611**	.529**	.126**	.083*	.330**
7. Emotional	4.00	0.56							1	.585**	.072	.067	.175**
8. Experimental	3.75	0.58								1	.044	.115**	.180**
9. Morningness	2.61	0.50									1	-.116**	.144**
10. Eveningness	3.29	0.71										1	.042
11. Distinctness	2.83	0.66											1

* $p < .05$; ** $p < .01$

When Table 1 is examined, it can be seen that the morningness-eveningness chronotype levels of the upper-secondary school students are highest in the eveningness sub-dimension ($M = 3.29$), while they are lowest in the morningness sub-dimension ($M = 2.61$); their cerebral dominance is highest in the emotional domain ($M = 4.00$), and lowest in the safekeeping domain ($M = 3.72$); their learning styles are highest in the abstract conceptualisation sub-dimension ($M = 3.22$), and lowest in the concrete experience sub-dimension ($M = 2.91$).

When the correlation coefficients between the variables shown in Table 1 are examined, the highest correlations with the concrete experience learning style are in the emotional ($r =$

.443) and experimental ($r = .437$) sub-dimensions of cerebral dominance. It can also be seen that the highest correlations with reflective observation and abstract conceptualisation are in the intellectual ($r = .340$ and $r = .437$, respectively) and safekeeping ($r = .330$ and $r = .478$, respectively) sub-dimensions, while the highest correlations with active experimentation are in the emotional ($r = .400$) and safekeeping ($r = .450$) sub-dimensions. When the correlations of the sub-dimensions of learning styles and cerebral dominance with chronotypes are examined, it can be seen that there are generally low-level significant correlations. The most significant correlations were found for morningness with concrete experience ($r = .087$) and the safekeeping domain ($r = .126$); for eveningness with reflective observation ($r = .166$) and the intellectual domain ($r = .132$); and for distinctness with active experimentation ($r = .176$) and the safekeeping domain ($r = .330$).

Findings for the Hypotheses Involving the Mediating Variables

Mediation analysis was performed to estimate the mediating effect of upper-secondary school students' chronotypes on the relationship between their cerebral dominance and learning styles. The direct and indirect effects of the variables are shown in Table 2.

Table 2

The Estimate of the Direct and Indirect Effects at the 95% Confidence Interval

Dependent Variables	Independent Variables	Direct Effect	Mediating Variables	Indirect Effect	Goodness-of-fit values*
Concrete Experience	Emotional	.70	Morningness	.71	$\chi^2 / df = 5.26$; NFI = .74, NNFI = .75, CFI = .78, RMSEA = .09, GFI = .83, AGFI = .79, SRMR = .08.
			Eveningness	.70	$\chi^2 / df = 5.27$; NFI = .77, NNFI = .78, CFI = .80, RMSEA = .09, GFI = .83, AGFI = .79, SRMR = .08.
			Distinctness	.73	$\chi^2 / df = 4.83$; NFI = .82, NNFI = .80, CFI = .85, RMSEA = .08, GFI = .94, AGFI = .91, SRMR = .06.
Reflective Observation	Safekeeping	.59	Morningness	.61	$\chi^2 / df = 2.98$; NFI = .89, NNFI = .92, CFI = .93, RMSEA = .05, GFI = .92, AGFI = .90, SRMR = .05.
			Eveningness	.58	$\chi^2 / df = 3.07$; NFI = .90, NNFI = .92, CFI = .93, RMSEA = .05, GFI = .92, AGFI = .90, SRMR = .05.
			Distinctness	.64	$\chi^2 / df = 3.80$; NFI = .86, NNFI = .88, CFI = .89, RMSEA = .07, GFI = .90, AGFI = .87, SRMR = .06.
Abstract Conceptualisation	Intellectual	.72	Morningness	.71	$\chi^2 / df = 2.24$; NFI = .91, NNFI = .94, CFI = .95, RMSEA = .04, GFI = .93, AGFI = .91, SRMR = .05.
			Eveningness	.73	$\chi^2 / df = 1.84$; NFI = .95, NNFI = .97, CFI = .97, RMSEA = .03, GFI = .97, AGFI = .96, SRMR = .03.
			Distinctness	.74	$\chi^2 / df = 4.58$; NFI = .81, NNFI = .80, CFI = .84, RMSEA = .07, GFI = .93, AGFI = .90, SRMR = .07.

Active Experimentation	Experimental	.56	Morningness	.55	$\chi^2/df = 1.89$; NFI = .91, NNFI = .94, CFI = .95, RMSEA = .04, GFI = .97, AGFI = .96, SRMR = .04.
			Eveningness	.56	$\chi^2/df = 1.79$; NFI = .94, NNFI = .96, CFI = .97, RMSEA = .04, GFI = .97, AGFI = .96, SRMR = .04.
			Distinctness	.56	$\chi^2/df = 3.90$; NFI = .86, NNFI = .87, CFI = .89, RMSEA = .07, GFI = .88, AGFI = .85, SRMR = .07.

* χ^2/df (Chi-square / degrees of freedom); NFI (Normed Fit Index); NNFI (Non-normed Fit Index); CFI (Comparative Fit Index); RMSEA (Root Mean Square Error of Approximation); SRMR (Standardized Root Mean Square Residual); GFI (Goodness of Fit Index); AGFI (Adjusted Goodness of Fit Index).

As can be seen in Table 2, the direct effect of the emotional sub-dimension on concrete experience is .70, and when morningness (.71), eveningness (.70), and distinctness (.73) are added as mediating variables, the effect of the emotional sub-dimension on concrete experience does not decrease. This means that the chronotypes as mediating variables have no effect on the correlation between the emotional sub-dimension and concrete experience. Similarly, the direct effect on reflective observation of the safekeeping sub-dimension is .59; the effect on abstract conceptualisation of the intellectual sub-dimension is .72, and the effect on active experimentation of the experimental sub-dimension is .56. However, the chronotypes do not have partial mediating effects on the correlation between the cerebral dominance variables and learning styles. Accordingly, the cerebral dominance variables affect learning styles, whereas the chronotypes have no effect on this relationship. When the fit indices of the models are examined (in Table 2), it can be seen that the fit indices are good (Kline, 2011b; Schermelleh-Engel et al., 2003).

Discussion

As a result of the study, it was determined that there is a correlation between cerebral dominance and learning styles. Based on this result, it can be said that the different learning characteristics formed by cerebral dominance in individuals are similar to the learning characteristics that form in individuals depending on their learning styles. In fact, there are studies in the literature that have revealed the relationship between learning styles and cerebral dominance (Bielefeldt, 2006; Özgen et al., 2011; Rhodes, 1990; Summers et al., 1993). The sample of these studies mainly consists of undergraduate students. In the four-quadrant brain model created by Herrmann, the parts of the brain are named as intellectual, safekeeping, emotional and experimental. According to this model (Herrmann, 1995), individuals whose intellectual quadrant (quadrant A) is dominant are analysers; they think logically and perform numerical operations (Lumsdaine & Lumsdaine, 1995). Those who predominantly use the A quadrant are logical and choose to learn from a logical and analytical source. In abstract conceptualisation, which is one of Kolb's learning style categories, the learning characteristics seen in individuals are such that, unlike experience-based learning, learning by focusing on logic and opinions is at the centre. In other words, in individuals whose learning style is predominantly abstract conceptualisation, logic is more prominent than emotions (Healey & Jenkins, 2000; Kolb, 1984).

According to the four-quadrant brain model, individuals with a dominant safekeeping quadrant (quadrant B) are organisers; they plan approaches, organise events and evaluate them in detail (Hermann, 1996). Those who are dominant in the B quadrant mostly prefer hands-on learning and are sequentialists (Lumsdaine & Lumsdaine, 1995). Reflective observation, which

is another stage of Kolb's learning cycle, is the stage in which the difference between what is learned and what is observed is organised by examining and planning in detail. Kolb stated that the reflective observation learning style is an effort to understand the basis of an event or phenomenon. At this stage, the aim is to reflect ideas and opinions on the subject, to question in detail and to achieve certain results (Kolb, 1984). Those who are dominant in the emotional quadrant (quadrant C) think according to their feelings and also have developed interpersonal social relations (Lumsdaine & Lumsdaine, 1995). In concrete experience, which is one of the stages of Kolb's learning styles, learning by feeling comes to the fore (Kolb & Kolb, 2005b). At this stage, it is stated that there are individuals who, rather than thinking about a subject, focus on understanding the situation with their emotions (Kolb, 1984). In Kolb's model of learning styles, active experimentation represents individuals who prefer to learn based on practice. At this stage, individuals' learning through practice and transferring what they have learned to real life are taken as the basis. Rather than observing, participating in activities gains importance (Kolb, 1984; Larkin-Hein & Budny, 2000). Individuals whose experimental quadrant (quadrant D) is dominant learn based on life and experience (Herrmann, 1995). As a result, it can be said that the four-quadrant brain model and the dimensions of Kolb's learning style that are matched above reflect individuals with similar characteristics. In support of these findings, as a result of the study, it was determined that there are significant correlations between the related variables.

As a result of the study, significant correlations of chronotypes with learning styles and the cerebral dominance variables were also obtained, albeit at a low level. However, it was concluded that the chronotype variables do not have a mediating role in the correlation between cerebral dominance and learning styles. There are studies in which undergraduate students are sampled in the literature examining the correlations between learning styles and chronotypes (Balci & Çalışkan, 2022; Davidson & Ritchie 2016). The chronotype-dependent differences in the structure of the brain (Zaręba, 2019) and the neural mechanisms affecting chronotypes (Rosenberg et al., 2015) have been investigated. In addition, besides the structure of the brain, it has been emphasised by neurophysiological theories that sleep state has an important effect on the functioning of the brain (Albán et al., 2019). The transition towards the evening type, which begins especially in adolescence, makes the individual need more sleep in the morning (Montaruli et al., 2017). It has been determined that in situations where there is no obligation to get up early, young people do not get up early and wake up at later times (Maukonen et al., 2017). Therefore, the evening type is more common in young individuals (Díaz-Morales et al., 2008). It was determined that the upper-secondary school students who made up the sample of the study mostly had the evening chronotype. The need to wake up early in the morning, which life conditions impose on evening types, causes an observable decrease in sleep quality (Taillard et al., 2003).

Sleep quality also has an effect on young individuals' school achievement (Škvorec & Bjelajac, 2016). In the literature, it is stated that with increased insomnia, students' motivation decreases, their depressive moods are observed, and the rates of being late to school and dropping out of school increase (Selvi et al., 2012). In this respect, it can be said that chronotypes, which also provide information about individuals' sleep patterns, are related to both learning styles and cerebral dominance.

Conclusions

According to the analysis results of the structural equation model (SEM) obtained in the study, concrete experience is positively correlated with the emotional subdimension (H3), and the same applies for reflective observation with the safekeeping subdimension (H2), abstract conceptualisation with the intellectual subdimension (H1), and active experimentation with the experimental subdimension (H4). As a result of the mediation analysis, it was determined that

the chronotype variables do not significantly mediate the relationships between learning styles and the cerebral dominance variables. According to this finding, hypotheses H11, H12, H13 and H14 were rejected. It can be said that the correlation levels between the chronotypes and other variables are generally low. The findings with a significant correlation are as follows: (H5). Safekeeping is positively related to Morning Affect. (H6). Morning Affect is positively related to Concrete Experience and Abstract Conceptualisation. (H7). The Intellectual, Safekeeping and Experimental sub-dimensions are positively related to Eveningness. (H8). Eveningness is positively related to Concrete Experience and Reflective Observation. (H9). The Intellectual, Safekeeping, Emotional and Experimental sub-dimensions are positively related to Distinctness. (H10). Distinctness is positively related to Active Experimentation, Abstract Conceptualisation and Concrete Experience.

This study contributes to the literature in terms of revealing the correlations between upper-secondary school students' cerebral dominance, learning styles and chronotypes. The findings may provide implications for determining learning styles, which have proven effects on student performance in the teaching-learning process, and, by establishing relationships between individuals' brain structures and chronotypes, the characteristics that direct learning preferences.

This study yielded findings about upper-secondary school students' learning styles, cerebral dominance and chronotypes. However, it does have some limitations. Firstly, the results of the study are based on self-reported measurements by the upper-secondary school students included in the sample. Future studies can gather more objective data by combining findings from qualitative and quantitative data, such as with mixed models. Moreover, the study is insufficient in terms of explaining the reasons for the correlations between the variables. For future studies, it can be suggested that the aspects of the correlations between the variables be clarified with regression studies that can be made between the related variables. In the study, the hypothetical correlations between cerebral dominance, learning styles and chronotypes are based on hypotheses that can be formed based on the literature. The correlations may have other possibilities, and this may be a suggestion for future studies. The findings obtained in the study reveal that students' learning styles and cerebral dominance are correlated. From this point of view, it can be said that in the teaching-learning process, performing activities in which students can use different brain quadrants can enable the development of different individual characteristics in students and, in parallel with this, strengthen and diversify their existing learning styles.

The authors declare no competing interest.

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